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A PLOUGH FOR THE TROPICS.

British manufacturers have not yet succeeded in making a plough in all respects completely suitable for use in the tropics, using the word to refer particularly to the equatorial zone. In this zone buffaloes or light cattle are the principal draft animals. They are used in pairs, seldom or never in teams of four, the hot enervating climate still further reducing their effectiveness. Hence we find that the first requisite of a good tropical plough is lightness in weight and in draft; and in order to fulfil this condition T or angle steel should be used for the beam. There are two main types of ploughs, namely, the swing and the wheel. Wheels have a two-fold value. By automatically regulating the width and depth they ensure a furrow slice of uniform dimensions being cut and properly inverted. This is a very important point when seed beds of large acreage are being prepared for crops that are to be reaped by machinery and must therefore ripen evenly. Again, wheels make possible double and treble furrow ploughs and the large steam ploughs that turn up to thirty furrows. Without wheels these ploughs could not be regulated. In the tropics we do not, as a rule, prepare large acreages in one block for seed, and the consideration of draft already referred to forbids the double furrow. Wheels are not, therefore, a necessity for us. In some respects they are a distinct hindrance because unless the wheels are correctly adjusted the plough will not work properly; but the villager does not as a rule understand how to adjust them or to manipulate bolts and nuts. Movable parts should, therefore, be reduced to a minimum; eliminated altogether were it possible. In the model plough we are now endeavouring to design this is

not quite possible because the share should be fitted with a point that can be replaced when it is worn badly. In most ploughs the whole share must be removed when the point is worn, and we have heard this quoted against some models. The brunt of the work is borne by the share point and when this wears away from underneath it will not penetrate the soil. Instead of a sharp cutting "point" the plough has to follow a blunt bevelled edge upon which it does not enter, but rides over, the land. The share should therefore be made with a replaceable point, so that only a minimum amount of steel has to be thrown away. The wing of the share need not be long and the mould board should be short. Furrows have not to be packed in the tropics because the soil when ploughed being usually dry and friable is broken up by the plough; not as in England turned in large continuous slabs which if not well pressed down by a long mould board are apt to curl back. The clean cut not being essential, coulters may be dispensed with.

The beam of the plough should be as short as considerations of stability will permit. There are two objections to a long beam. One is that additional weight is given to the implement; the other that a long beam gives the advantage of leverage in favour of the draft cattle as against the ploughman, the point of the share being the fulcrum. In the English swing ploughs with no wheels to lock them to the land, uniformity of furrow depends ultimately upon the skilful leverage exerted by the ploughman, who is therefore given a short beam and long stilts. With the tropical plough the stilt should be short to allow of the ploughman keeping within reach of the cattle, which not being so intelligent as horses cannot be so easily controlled. We purposely use the singular because one handle is in our opinion all that is required for steadying and directing a small, light plough such as we have described. We may sum up by saying a model tropical plough can be evolved by steadily keeping in view the supreme importance of lightness, simplicity and effectiveness; from which will follow the fining down of the frame, the elimination as far as possible of movable parts, and the adoption of the replaceable share-point.

R. N. L.

COCONUTS.

THE COCONUT INDUSTRY OF CEYLON.

The high prices that manure has reached and the protracted droughts that are becoming so common have had the effect of making planters turn their attention to the principles of dry farming. I trust that we shall soon have the benefit of a useful record of the results of their experiments. While on the subject of agriculture generally, I must not fail to mention that the delays and difficulties attending the purchase of Crown land and in obtaining Title Plans therefor continue to discourage the developing and opening up of new areas and that we shall have to again press on Government the necessity for a proper land department. The coconut industry has suffered from drought as well as by the want of freight. I was told by the Honorary Secretary that in last year's exports there was a shortfall of 28 million nuts compared with the previous year. However, in my opinion the position of the industry is sound. The coconut has become more widely known and appreciated as an article of food and new markets have arisen. Though its new rival the palm kernel came into prominence last year, I do not think it will enter the field of competition as a cultivated product.

—L. C. P. A. CHAIRMAN'S REVIEW.

COIR FIBRE IN CEYLON.

The fibre export shows a falling off in bristle fibre from 82,892 cwt. in 1914 to 66,429 cwt. and in mattress fibre from 144,112 to 124,830 cwt., while yarn was about stationary at 98,275 cwt.

The price of bristle which was at the beginning of the year at Rs. 7 per cwt. dropped to Rs. 5·75 and Rs. 6 from May to June and thereafter it rose gradually to Rs. 8·50 in December, while mattress starting at Rs. 1·50 and Rs. 1·25 fell to Re. 1 in April and from June again rose to Rs. 1·50 and reached Rs. 2 in December. The top price Rs. 2·30 was reached in November.

The principal purchaser of bristle being England which took 56,726 cwt. out of a total of 664,429 and 64,396 mattress fibre out of a total of 124,830.

The Australian Colonies took about 20,000 cwt. and India 21,515 cwt. Japan which it was thought would buy largely took only 4,547 cwt. bristle and 309 cwt. mattress fibre.

Your Committee has entered into correspondence with firms in England with a view to establishing a brush making industry in the heart of the Fibre Mill Districts and will in the current year pursue the matter further.

—L. C. P. A. REPT. FOR 1915.

RUBBER.

ESTIMATE OF PLANTATION CROPS IN 1916.

We have not seen any detailed estimates for plantation rubber during 1916 though several general statements have been made. Again we will adopt our old custom and disclose the basis on which our estimate is framed.

Our annual estimate has always been the subject of considerable attention, and we hope that men connected with all departments of the industry will send us their views if they differ from the estimate we now give.

The estimate for the current year is based on the assumption that all areas planted prior to and during 1910 will be tapped during 1916. Of course, we are quite aware that many estates are yielding rubber before they have entered their fifth year. We have, however, to bear in mind that original plantings do not always continue their existence, and that there are some parts of every country—especially when intercrops have been extensively grown—where the yields and the rate of growth of the rubber trees are below normal.

CEYLON AND SOUTH INDIA.

The factor which must be borne in mind is that there was not a very large increase in planted acreage in Ceylon during 1910. For this reason we have allowed that the tapped acreage will yield an average of 300 lb. per acre; that is regarded as high by many people familiar with Ceylon. The area to be tapped during the present year in Ceylon shows, in point of fact, very little increase over that tapped even during 1914. We have figures before us showing that some of the old estates in Ceylon are giving 500 lb. per acre per annum—a high yield—in their 12th year. During 1915 Ceylon yielded about 20,000 tons from 175 acres, averaging about 250 lb. per acre; a higher yield, per acre, should be obtained this year.

In South India, Borneo, and islands in the Pacific approximately 50,000 acres were planted prior to or during 1910. We have estimated that the yields from these areas will be at the rate of one ton per ten acres, and thus give us 5,000 tons of rubber. The greater part of this acreage is in South India, which, up to now, has not given a high average yield per acre.

MALAYA.

Malaya will, as in the past year, give us the biggest crop; in fact, the yield from Malaya should be approximately half the total plantation output during 1916. We have estimated the yield, from what is acknowledged as the minimum acreage being tapped, at the rate of 350 lb. per acre. We could take a smaller yield and a larger acreage—justifiable according to some authorities—and arrive at somewhat similar figures. The F.M.S. exports for 1915 totalled 44,524 tons, December alone amounting to 5,111 tons. The Straits Settlements exported over 34,000 tons, bringing the total for Malaya to

over 79,000 tons. The figures of export from F.M.S. and S.S. and Ceylon must not be taken to mean production in those areas. The Malayan figures include materials going under the name of rubber, but which possess only small percentages of caoutchouc; they also include some of the rubber produced in Borneo, Java, and Sumatra. The Ceylon export figures may also include quantities from further East. It is impossible, without figures of import and export for each Eastern port, or of verified stocks at the beginning and end of the year, to say what the actual production of each country was for 1915.

DUTCH EAST INDIES.

We have previously given an estimate of the acreages planted in Sumatra and Java with rubber trees. Unfortunately it is very difficult to give an accurate statement of the areas occupied by rubber trees other than Hevea in these countries, during the years 1909, 1910, and 1911. We have conferred with gentlemen of experience in these countries, and the following is our estimate of the total acreages under rubber in Sumatra and Java :—

		Java.	Sumatra.	Total.
1909	...	100,000	70,000	170,000
1910	...	140,000	110,000	250,000
1911	...	190,000	175,000	365,000

In arriving at these figures we have made reasonable allowances for certain areas which we know were planted with Ceara in both countries. Our Dutch friends have advised us that they estimate a production of 16,500 tons from Sumatra, and 20,000 tons from Java during 1916. Our estimate of production is 27,000 to 30,000 tons from these islands. In past years the Dutch East Indies have not been of first rate importance so far as rubber production was concerned; this year, however, they become most important, and should give more raw rubber than all the plantations in Ceylon and South India. It is because of their growing importance and the very large British, Dutch, and Belgian interests involved that we have dealt with the subject in detail.

TOTAL ESTIMATE.

The total production from Malaya, Ceylon, Dutch East Indies, South India, Borneo, etc., on the above basis is 132,700 tons. To this must be added some crop from over 200,000 acres planted during 1911. It is most difficult to calculate the yield from areas planted in that year, as much will depend on the price of the commodity. If rubber remains at anything near its present level it is quite possible that as much as one ton per ten acres may be obtained from the 1911 clearings; if the converse is true, probably half that return can be relied upon. Our total estimate, therefore, is from 132,700 to 142,700 tons for 1916.

The estimate we give is larger than that given by some of our friends with whom we have conferred, but we are unable to see how plantations can avoid yielding the quantities we have put forward. It must be remembered that the British exports of rubber alone reached about 100,000 tons last year; to this total must be added some of the production from Dutch colonies and islands in the Pacific. The estimate of 134,000 tons of plantation rubber for 1916 is, in our opinion, too low.

The production from Brazil, Mexico, and Africa very materially depends upon prices and the war, but a total, including all grades, of 40,000 tons may be expected in addition to the plantation supply. In all these estimates one must not forget that plantation rubber loses less than one per cent., whereas wild grades, on washing, lose from ten to forty per cent. Under these circumstances the wild crop of rubber can only be regarded as very insignificant.—India Rubber Journal.

RICE.

COST OF PADDY CULTIVATION IN BURMA.

During the year careful records were made over large areas in order to determine accurately the cost of each operation in paddy cultivation. In the case of field operations the figures obtained may be regarded as giving a fairly accurate statement; in the case of thrashing by the Ransome's Rice Thrasher and Oil Engine, however, it is possible that further trials will show the cost to be much less. The outfit had just been obtained when the trials were made and a considerable amount of trouble was experienced in getting it properly adjusted. It was found also that the paddy had been cut too long while the heavy shower of rain which fell in January helped to make thrashing more difficult.

In making the calculations the local rates of labour were taken, but in the case of operations with cattle depreciation and interest on capital cost, and not the charge for hire of bullocks, were used. It was assumed in all cases that a pair of bullocks cost Rs. 200 and do five working seasons before they are worn out:—

The following figures were obtained:—

Operation.	Rate per acre paddy cultivation. Rs.	A.	P.
Ploughing	1	6	0
Harrowing	2	2	0
Setun or grass cutting	0	10	0
Plucking transplants	1	0	0
Carrying transplants from nursery to field	0	8	0
Transplanting	4	0	0
Reaping (contract)...	5	0	0
Thrashing (annas 2 and pies 6 per basket thrashed) at yield of 35 baskets	5	11	0
Total	20	5	0

If we add on 1 per cent. for minor operations, such as tending bunds and irrigating during the growth of the crop, we may put the cost down at about Rs. 21 per acre. This is greater than is usually stated and is probably a good deal higher than the ordinary cultivators' outlay. The figures, however, indicate that in any case the profits of paddy cultivation when expressed in money are not large.—REPORT OF THE HMAWBI AGRIC. STN., BURMA.

TOBACCO.

BLACK, SHED, AND STEM ROT OF TOBACCO.

This paper (Agr. Exp. Stn., Wisconsin, Research Bull. 32) describes various experiments to determine the causal organisms of the above diseases of tobacco.

1. *Black Rot* is a disease of the tobacco leaf and occurs during the fermentation process. The rot is due to the development of the fungus *Sterigmatocystis nigra* on the leaves, causing them to blacken and decay. The disease is primarily due to excessive moisture and a temperature of 30° to 40° C. following infection by the fungus. Thus the control of the black rot disease must depend largely on the regulation of the percentage of moisture in the leaf and the temperature of fermentation.

2. *Shed Burn and Stem Rot* of tobacco may be due to one or more species of saprophytic fungi. *Fusarium* is most commonly the cause of these diseases in Wisconsin. The difference between the two diseases is chiefly one of location. If the fungus attacks the midrib, the disease is called stem rot; if the leaf tissue is attacked, the disease is called shed burn.

To control these diseases, the regulation of the temperature and moisture in the curing shed is of supreme importance.—A. B. in the Jour. of the Royal Hort. Society.

TOBACCO SEED BEDS.

Mr. F. Charlan, Chief of the Tobacco Division of the Dominion Department of Agriculture, Ottawa, Canada, is the author of an interesting bulletin No. 21 on Tobacco Seed Beds from which we extract the following which should prove of interest to the readers of this Journal.

CARE AND MANAGEMENT OF THE BEDS.

Watering.—Watering should be done with a great deal of moderation. The beds should not be drenched, but simply kept moist. When the grower judges that the time has come to water the beds, he should do so chiefly during the hot hours of the day, keeping the sashes open as little as possible; lukewarm water should be used and applied by means of a watering can, the spout of which is perforated with very small holes. By so doing, he will avoid uncovering the roots of the seedlings; if, however, some up-rooting is observed, a little mould should be spread in order to cover the roots. Later on, when the seedlings have become stronger, when they are being hardened off by raising the sashes during a part of the day and when the evaporation becomes more active, a large quantity of water may be applied to the bed.

But in this case it is better to give several sprinklings, taking care, however, not to sprinkle too late at night; lukewarm water should always be used and no more water should be applied at any time than is strictly necessary to maintain the humidity of the beds. In this way, losses of heat are avoided, while the seedlings are provided with all the water that they require. Again, if too large a quantity of water were applied at any one time, it might interfere with the fermenting of the layer of manure supporting the mould in a hot bed or in a semi-hot bed.

Note.—Pure water only should be used for watering, except in special cases, mentioned further on. It should be slightly warmed by being exposed to the sun, or to some other source of heat.

Airing.—Beds should be aired as much as possible, and the sashes should be raised whenever it is possible to do so without exposing the beds to an undue amount of cooling off.

When the beds are protected by rather loose canvas, an exchange takes place between the atmosphere of the beds and the outside atmosphere which, to a certain extent, may be considered a real ventilation. However, it is a good plan to lift the canvas and uncover the seedlings whenever the weather is favourable.

The more impervious the surface shelter is, the greater will be the æration required. A close atmosphere in the bed is very injurious to the seedlings; it is important, therefore, to keep the glazed sashes up, almost all the time, except during very cloudy weather and during the night.

Some of the plates in this bulletin show how a good æration may be obtained when glazed sashes are used.

By raising lightly the sashes on the lower part of the frame, a good temperature is obtained and sunstrokes are avoided.

In plate VI a [not reproduced] the top part of the frame only is raised. This allows of a rapid exit of hot and impure air. If the opening is not very large, the bed does not cool off noticeably.

Another way of arranging the sashes, by which a regular draught of air may be created upon the bed is shown in plate VI b [not reproduced]. This arrangement is recommended specially during hot days, and when the sun is very strong.

It is also possible to slide the sash one way or the other, to make sure that all parts of the beds are at the same temperature.

Again, during the hot hours of the day, it is always possible to cover the sashes with light cloth, thus largely reducing the quantity of heat absorbed.

By combining the use of the sashes and that of the cloth, it is possible, near the end of the growing period, to keep the bed at a lower temperature than the outside atmosphere. In this way, growth is retarded instead of being hastened.

Hoeings.—Unless the soil has been steamed, a number of other plants will appear on the bed, no matter how carefully the latter has been prepared. It is necessary, therefore, to hoe the beds in order to free the young tobacco of seedlings and give them a chance to grow unhindered. The weeding, which should be preceded by a watering if necessary, is done by hand or with the point of a knife during the hot hours of the day. Care should be taken not to lay bare the roots of the tobacco seedlings, and a light quantity of mould should always be spread after this work. Weeding should be done at proper intervals, until the tobacco seedlings cover the whole surface of the

beds and have become strong enough to prevent any other plant from growing in their midst.

However, there is a method by which weeding may be reduced to a minimum. When glazed sashes are used, the bed is prepared fairly early and heated, while kept moist at the same time, until all the weed seeds that are in the mould have germinated. When the weeds are well up, they are destroyed by raking, the bed is put again in proper condition and sown with tobacco.

Moulding.—This operation consists of spreading an even and thin layer of very fine mould on the whole surface of the bed after sowing, or after watering, thinning or hoeing, so as to cover the roots of the seedlings which may have been laid bare.

The mould which is to be used for this operation should be prepared in advance.

When the beds have been treated with formalin or by steam, the mould which is used for covering should, of course, be submitted to the same treatment.

Thinning.—No matter how carefully sowing may have been done, it often happens that the stand of the seedlings on the beds is not quite uniform, and that they are much too thick on some parts. It also very often happens that too much seed is sown, causing a very thick growth of seedlings.

The beds should be thinned early, before the plants have made much growth; the strongest seedlings are kept, and these having more space, develop rapidly and produce an abundance of roots. By this means, the production of slender, elongated, or "spindly" seedlings, too weak to stand the handling before transplanting, and taking root with difficulty, is avoided.

An instance will show the importance of this work; on one of our beds the seedlings were so thick that they were yellowing in spots, just as though they were diseased. After a good thinning, everything was normal; the remaining plants became green again, grew in regular manner, and no disease appeared.

Thinning, like weeding, should be preceded by a light watering, facilitating extraction, and followed by a sprinkling of vegetable mould. The latter is particularly important.

Nursing.—This operation is practised when the seedlings are too thick. Some of the strongest ones are removed and planted on another semi-hot bed or in good garden earth. By this means, a small number of excellent seedlings may be obtained and they may be reset with a part of the soil in which they were growing. However, this method has the objection of necessitating a great deal of labour. The use of such seedlings is not recommended for the production of seed, specially in the case of light varieties, as it would soon result in a deformed type, no longer answering the needs of the market for which it is grown. The best way is to have a thin stand on the beds so as to secure strong and uniform seedlings.

Hardening off and acclimatization.—This operation consists of preparing the young plant for the conditions in which it will be placed in the field.

As a general rule, the soil of the field is very different in composition from that in the bed, so, in order to correct the transition to a certain extent, it is recommended to leave as much as possible of the mould adhering to the roots; care should be taken therefore to avoid shaking the seedlings.

Seedlings are hardened off chiefly by decreasing the proportion of humidity in the bed and increasing the length of the exposure to the sun and to the outside temperature. Hence, during the period of acclimatization, which may last from eight to fifteen days according to the requirements of transplanting, the beds should be kept covered as little as possible and watering should be decreased.

Hardening off is not so easy as is generally supposed.

For instance, if, in an endeavour to reduce the proportion of humidity, watering becomes insufficient, the growth of the plants will suddenly come to an end and the stems of the young seedlings, instead of remaining white and tender, will take a green colour and harden rapidly. Seedlings of this kind will stand drought better, perhaps, than tender seedlings, but they will not produce so many leaves. The removal of the shelters, especially when a first lot of seedlings has already been extracted from the beds, may have the same results. While reducing watering, evaporation should be decreased by sheltering the beds with light canvas cloth, in case the work of transplanting should take longer than was anticipated.

Lastly, if the seedlings, in spite of all these precautions, should show a tendency to harden or to spindle, or to make an excessive growth, it would be better to have them extracted at once and keep them in the manner indicated in the following paragraph.

EXTRACTION AND CHOICE OF THE SEEDLINGS.

Stocky seedlings with a tender green foliage, a white stem and abundant root hairs are the best for transplanting. A good height is from three to four inches. Yellow or spindly seedlings or those showing green or yellow streaks (a symptom of disease) should be discarded.

Before extracting the plants, the beds should be well watered so as to avoid breaking the roots or disturbing the soil too much; care should be taken also not to shake off the earth adhering to the roots as this earth will facilitate the recovery of the seedlings when transplanted.

The extracted seedlings are placed together loosely, in a slightly slanting position, in a basket or any other vessel with a wide opening and a flat bottom, covered with a damp cloth and kept in a cool place, cellar or silo, until the time when they are to be used. They may be kept in this condition for a fairly long time, but it is better to use them as soon as possible, in order to prevent wilting or yellowing.

Upon no account should the seedlings be watered after being pulled out, as they would rapidly decay.

After extracting, a good quantity of mould should be spread on the bed so as to cover the roots of the remaining plants which have been slightly raised. A new extraction may be made a few days after the first one.

Extractions should not be made in too close succession. It is wise not to make more than two extractions from any one bed for transplanting. A third extraction may be made a little later for resetting, but even for this work, it is better to use seedlings coming from a bed which has not been called upon to supply too many plants.

No matter how carefully the extraction is made, the roots of the remaining seedlings are always disturbed.

It has been observed on our plantations that the number of diseased plants is always in proportion to the number of resettings, and this observation was made in a season when, owing to the insufficiency of our beds, the seedlings came from a third and sometimes a fourth extraction.

The best plan, therefore, is to make thin sowings, at various dates, so that all the plants from one sowing may be ready at the same time, and to sow a sufficient number of beds so as to supply as many and even more seedlings than are required for transplanting. A bed one hundred feet square, may, with a fair degree of success, easily yield from eight to nine thousand seedlings.

Sometimes, towards the end of the transplanting period, the grower may be compelled to use seedlings that are a little "spindly." Such seedlings should be set a little deeper than the others, so as to provoke the growth of adventitious roots, and restore to the plant, to some extent, the strength which it has lost during the last few days that it was on the bed.

DISEASES OF TOBACCO SEEDLINGS.

A scientific study of the diseases of tobacco plants would be out of place in a practical bulletin of this kind. This subject, which is not as yet completely elucidated, is one which should more properly be dealt with by a botanist or a pathologist.

It will be sufficient for the grower to know that these diseases are caused by the development of organisms on the young stems or the roots of the tobacco plants. These organisms, which belong to an order of inferior cryptogams or mushrooms, hardly visible to the naked eye, find a suitable medium for their growth in over-heated beds, kept too damp, insufficiently aired and where the stand is too thick.

For the sake of convenience, these diseases will be divided into two groups:—(1) the diseases affecting the visible parts of the plant, from the collar to the leaves; (2) those affecting the subterranean parts of the plant viz., the roots.

(1) *Damping Off.*—In the first case, some seedlings are seen to wither suddenly, in a few hours time, on one or several parts of the bed, generally in the dampest parts, and on those where the stand is the thickest. The seedlings that are affected wilt rapidly; they collapse as it were on the top of the bed, forming a matted mass. This disease has been called damping off. Three different organisms, all three attacking the aerial parts of the plants may be responsible for this disease: Pythium Debaryanum, Sclerotinia or Rhizoctonia. The latter, however, attacks the root and stem indifferently.

The injury is specially visible at the collar (the part of the plant between the root and the stem); the collar becomes dark, like brown cork, and hard. As a rule the roots of the affected plants have not as much hair as have those of normal plants.

A careful examination of the surface of the bed will show a net of white filaments (mycelium) surrounding the young stems of the dead seedlings.

When the plants are already fairly developed when the disease appears they do not necessarily perish. A sort of canker forms above the collar. This canker, easily seen with the naked eye, enables one to recognize the disease at extraction time. When the disease is caused by Sclerotinia, the canker sometimes develops on a higher part of the stem; in this case it is easier to make a diagnosis. All diseased plants should be discarded, and it will be better to give up the bed entirely if there is a large proportion of diseased seedlings, as they would surely prevent the grower from securing anything like a full crop.

(2) *Root Rot.*—It is not always easy to ascertain the presence of this disease, as it generally starts on the underground parts of the plant. The destructive agent is generally *Thielavia Basicola*. The presence of Rhizoctonia has sometimes been observed, but the latter attacks more particularly the parts of the plant above the ground. This disease is called "Tobacco Root Rot."

The seedlings which are attacked grow very slowly; this slowness is sometimes attributed to the lack of plant food in the mould, to the lack of heat or to the insufficiency of water. Sometimes the stem shows a tendency to harden and the foliage becomes dark When this symptom is observed, as indicated by G. P. Clinton, the seedlings should at once be taken out and their roots carefully examined; this examination will show the real cause of the trouble.

In the case of damping off, it often happens that seedlings die upon the bed; with the tobacco root rot, the infection may not be observed on the beds if it is not very severe, and it is carried with seedlings on the field, where it does considerable damage for several years in succession. As a matter of fact, the infection by *Thielavia Basicola* renders the land unsuitable for the profitable growing of tobacco, for a number of years.

In the more frequent cases (general infection or infection localized in a part of the bed) the seedlings that were thought to be normal are found to have practically no roots. In the majority of cases, the main root is destroyed as well as the secondary roots, only the adventitious roots are left, which have developed in the immediate neighbourhood of the collar, under the pressing requirements of the plant, and have helped the latter to live. Instead of roots one seeks dark stubs, the last remains of the roots that have been destroyed.

It seems almost unnecessary to dwell on the necessity of discarding such seedlings as well as all the seedlings coming from the infected seed bed.

Sometimes, a more careful examination is necessary; the root system is not entirely destroyed, but a good part of the root hair has disappeared. Sometimes the latter subsist, but the extremity of the young roots appears to be burnt. This is a mild form of *Thielavia Basicola*, perhaps the most dangerous of all, as, being unnoticed, it is often carried from the bed to the plantation.

Such seedlings, transplanted in a healthy and fertile soil, will give a crop but they will inevitably ruin the soil by spreading the germs of the disease and making it unsuitable for the profitable production of tobacco for years to come.

Bacterial Canker.—Some investigators claim to have found a soft bacterial canker on the young seedlings. This canker, which often appears on the European tobacco fields (G. Delacroix) propagates through the vessels and develops particularly on the stem, at the axil of the leaves and on the leaves, at the point of intersection of the ribs. It appears in the shape of dark and soft spots of a livid hue, which, on drying out, form a real ulcer. It has never been observed as yet in Canada.

Mosaic Disease.—Mention should also be made of the mosaic disease which, up to the present, has been thought to be caused by a purely physiological disorder. On the seed beds, it appears in the shape of light streaks or light swellings on the green parts of the plant. Generally the roots

of the affected plants are poorly developed. Suspected seedlings should be discarded. Better give up the entire bed if possible.

PREVENTIVE TREATMENTS—REMEDIES.

How can the grower prevent or check these diseases which threaten to destroy the crop at the very beginning of the growth?

As regards the mosaic disease, it is very difficult, in the present state of our knowledge of the subject, to recommend an efficient treatment. This disease is supposed to be caused by trouble of nutrition, arising out of sudden variations in the conditions of growth. To avoid these variations is, therefore, the first consideration, but this is a difficult matter as it is almost impossible, in the majority of cases, to keep the humidity, the temperature and the æration of the bed always as regular as they should be. Outside atmospheric variations will always exert a considerable influence, which, in most cases, will decide the final results. It must not be forgotten that the mosaic disease occurs only very occasionally on the seed beds, and that it may, according to the season, be the logical consequence of the measures that should have been taken to prevent the more frequent and more serious diseases mentioned in this chapter.

Predisposing Causes.—For all other cases, it may be stated, in a general way, that the main causes favouring the appearance of diseases on the beds are the following: excess of moisture, lack of air and light, too high temperature, too thick a stand, infection of the moulds.

The germs of diseases may be contained in the mould that has been put in the bed, or they may be accidentally introduced during the period of growth. They are always very dangerous but the damage caused is much larger when they find favourable conditions for their development and when the young plants, on the other hand, hindered by unfavourable conditions, can only offer a minimum of resistance.

Remedies.—This is specially the case as regards the diseases constituting the group designated under the name of "damping off." Very often the disease may be checked by decreasing watering, by giving more æration and by thinning. The conditions thus created are most favourable for the growth of the mycelium and the injury may be completely checked.

The following mixture for use as a spray is recommended by SMITH and BLACOW:

3 ounces flowers of sulphur.
4 ounces copper sulphate finely crushed.
14 pounds air-slaked lime.
or a solution of formalin at 3/100.

Good results have been obtained by MR. CHEVALIER at Farnham, P.Q., with a solution of formalin, 1/100. It is very probable that a solution of 2/100 could be used safely.

The method is as follows: as soon as damping off is observed on a part of the bed, cut with scissors all the seedlings that are on this part, taking in, at the same time, one or two inches all around, on the healthy parts of the bed. On this clear spot spread the SMITH-BLACOW mixture by means of a very fine sieve, or apply a good quantity of formalin solution (2/100). It is necessary to cut a little more than the affected part, so as to be quite sure of removing all diseased parts. In any case, the seedlings would not survive the application of the formalin solution or of the disinfecting mixture.

Such treatment can only be applied when the attack is comparatively light, limited to certain spots, and when the bed is accidentally invaded. When the whole of the mould is infected, the treatment is useless as the extirpation of the disease would involve the practical destruction of the seedlings. The only remedy in this case is a preventive one: the disinfection of the soil.

In any case, this seedling is an absolute necessity and too much importance cannot be laid on this point. Too thick a stand of seedlings may by itself cause serious disorders. The young seedlings are smothered between the earliest ones, and being unable to clear themselves, they decay and fill the bed with refuse constituting an extremely favourable medium for the development of fungi.

After the thickness of the stand, the excess of humidity is perhaps the next cause. As a matter of fact, damping off is generally observed on the parts of the bed where dripping occurs (under glazed sashes) or in such parts where evaporation is the least active, near the frames. Therefore, the sashes must be perfectly tight and they should be given a sufficient slope, so that rain water or water which has condensed on the inside surface of the glass may easily run off. Watering should be moderate.

Tobacco Root Rot.—As will be seen, the treatment of a bed that has been attacked by damping off is, to a certain extent, practicable, but with tobacco root rot, the only remedy seems to be the control of æration and of watering. Even then, however, injury can only be slightly reduced, and, in any case, it would be extremely unwise to use seedlings coming out of a bed attacked by root rot.

On the bed where the top layer consists of a sandy soil, having easy access to air and quick to dry off, it has been observed that *Thielavia* attacks specially the deep parts of the roots (root hair) and that the neighbouring parts of the collar are seldom attacked. This does not make any difference from a practical point of view, as the attacked seedlings must be destroyed, but it is a proof that the excess of humidity and lack of air are predisposing causes.

It is also advised to avoid the use of mould containing undecomposed organic manure. Mention of this fact has already been made in a preceding chapter.

There is only one preventive remedy for tobacco root rot: viz., the disinfection of the mould.

This treatment is very efficient with any form of rot, while the remedies indicated above are only good for "damping off" and are absolutely useless for tobacco root rot.

This paper, (Agr. Exp. Station, Mass. Bull. 161) shows that liming a soil increases the size of the clover plants and that the percentage of nitrogen is increased when the soil is so treated, or on soils without an application of nitrogen, or when supplied with sulphate of ammonia. The increase in the assimilation of nitrogen was apparently promoted by the action of the lime on the properties of the soil, and not by its action within the plants.—Journal of the Royal Hort. Soc.

FRUIT.

DRESSING WOUNDS OF FRUIT TREES.

G. H. HOWE.

It has long been the custom of fruit-growers to use paints, tar, waxes, and other substances as coverings for wounds in trees. The objects of such treatment were to enable the trees to heal the wounds quickly and to prevent the entrance of fungi and insect pests into the wounds. Experiments were devised to determine (1) if such treatment was necessary, and (2) to find if any substance used was superior, to others, for this purpose. The trees used in the work were apples and peaches, while the materials for covering the wounds were white lead, white zinc, yellow ochre, coal tar, shellac, and avenarius carbolineum. Dressings of these substances were applied at different periods of the year and upon wounds of different ages. The conclusions arrived at were as follows :—

1. In all cases, undressed pruning wounds have healed more rapidly than those whose surfaces have been protected.

2. Shellac seemed to exert a stimulating influence upon the wounds during the first season, but this effect disappeared in the second season. Of all materials used, shellac was least injurious.

3. Avenarius carbolineum and yellow ochre cause so much injury that neither substance should ever be used.

4. Coal tar is also injurious, but quickly disappears either through absorption or evaporation.

5. White lead and white zinc caused some injury at the outset, but the wounded tissues recovered quickly, and the injury was not very marked at the end of the second season. These two paints are the best of the protective substances used, and of the two white lead is the better.

6. Nothing is gained, in the treatment of wounds, in waiting several weeks before applying any of the various dressings used in these experiments.

7. The treatment of peach-tree wounds with any of these substances cause so much injury that it may be said that the peach should never be treated with any of them. This probably applies to all stone-fruit trees.

8. There is nothing to show that it is worth while to treat wounds, large or small, of fruit trees with any of these substances used in the experiments. But in the case of very large wounds it may prove of value to cover with a dressing of white lead.—A. B. in Journal of the Royal Horticultural Society.

RINGING OF FRUIT TREES.

G. H. HOWE.

The object of the ringing is to induce and increase fruitfulness, but it is an operation requiring great care and should only be resorted to when all other means fail. The success of the operation hinges upon the fact that in

June and July the greatest activity of the cambium is apparent, and this leads to the rapid formation of new bark. Any attempt at ringing when the growth is dormant or sluggish always results in the death of the tree.

Experiments were made upon apples, plums, pears, and cherries and extended over three years. The objects were to determine, if possible, the extent to which fruit trees can be ringed without injury, and in what degree, if any, the operation induces and stimulates fruitfulness.

The conclusions arrived at were:—

1. Ringing seems to favour certain organs for a time, but devitalizes others.

2. The removal of narrow strips of bark is less injurious to plant growth than the removal of wider rings.

3. Under certain conditions, ringing may induce and increase fruitfulness in apples; but it rarely has these favourable effects on other fruit trees.

4. Only young and vigorous apple trees—occasionally, pear and cherry trees—can survive ringing.

5. Ringing stone-fruit trees is not recommended. Nearly all so treated in the experiments died.

6. Ringing has no apparent influence upon the size, colour, or maturity of apples.—A. B. in the Jour. of the Roy. Hort. Soc.

AN AID TO INVESTORS IN RUBBER COMPANIES.

We are in receipt of the January issue of the monthly Rubber Companies Position issued by Messrs. W. H. Rickinson & Son, Stock Exchange Printers, of 3 Great Winchester Street, London Wall, E.C.

The object of this booklet is to assist investors in ascertaining the financial position of various rubber companies.

The particulars given therein include statements as to Capital (authorised and issued) acreages, rubber outputs, lb. per planted acre, lb. per £ of issued capital, Capitalisation, Market Capitalisation, Balance of Capital, etc., etc.

A large majority of the estates dealt with are in the F. M. S., but it is the intention of the publishers to introduce from time to time details of additional companies.

The figures given in the booklet should be of considerable value to investors.

L. E. C.

The Agricultural and Co-operative Gazette (Nagpur) for January last says:—Crop experiments were carried out last year in 90 villages in Chattisgar Division to compare the out-turns of transplanted and broadcasted rice. The results showed that transplanting gave an average increase of 869 lb. of paddy per acre worth at least 28 rupees and 8 annas. To produce this no extra capital is required and the means of securing the higher yield should appeal to the poor man.

SPICES.

CURING VANILLA.

It would appear that the process of curing Vanilla has as its basis the following course of events.

The pods are first plunged for a few seconds into boiling water: this has the effect of killing some of the more superficial cells, thus permitting the diffusion of the enzyme or ferment from one cell to another. Living cells inhibit the movement of the enzyme. On reaching the other cells the enzyme acts upon the glucoside from which vanilla results and the fragrant odour of vanilla is developed.

The next operation consists in sweating the pods. It would seem that this operation has for its object the promotion of the death of more cells, and progressively the death of all, coupled with the steady diffusion of the enzyme from cell to cell, and the liberation of the whole of the vanillin. During this part of the process the object is to keep the pods warm and moist; drying is prevented, thus aiding the death of the cells, and the diffusion of the enzyme. The progress of the changes is ascertained by the expert curer from the feel of the pods as they change from the fresh state, containing living cells, to the stage in which the cells are dead and the vanillin liberated. This constitutes the main features of the art of the curer.

When the changes described are completed, the next object is to dry the pods sufficiently to enable them to keep; this being done, the vanilla is ready for bundling for sale.

The drying is accomplished by placing the trays of fermented pods in a cool well ventilated place, out of the light.

The middle stage is obviously the important and difficult one. It might be experimentally carried out as follows.

The pods, after being plunged in boiling water, should be placed in a glass-topped box exposed to the sun. The temperature inside the box would quickly rise to a considerable degree, and this could be regulated, as experience dictates, by shading by means of cloths or other forms of shade over the glass top of the box.

The work might be done in an apparatus somewhat resembling a cucumber frame; this might be made of any convenient size, from a small experimental apparatus up to a large commercial one. The chamber of the apparatus should be fitted with shelves or racks on which the vanilla pods may be laid in shallow trays. Access may be had to the interior by means of doors suitably placed at the sides and ends to enable the trays to be put in and their contents examined freely.

It would be useful if experiments were conducted on the lines here indicated.

It may be pointed out that the protoplasm of cells is killed by exposure to temperatures of about 65° to 70° C., while the enzyme will stand a somewhat higher temperature; its power on inducing change is, however, destroyed at temperatures somewhat below 100° C.—Agricultural News.

PREPARATION OF JAMAICA GINGER.

Jamaica ginger, as is well-known, is the best grade of ginger on the market at the present day, realising a price of 55/- to 75/- per cwt.

The following information regarding the curing and preparation of the product, issued by the direction of Sir William Robinson, K.C.M.G., for the use of District Agricultural Boards in Trinidad, is here published for the use of those who are engaged in its cultivation:—

"Ginger is propagated by the smaller pieces, prongs, or protuberances of the root, each of which throws up two different stems; the first bears the leaves, and rises to the height sometimes of three feet or upwards, but its usual growth seldom exceeds 18 inches. It thrives best in a rich, cool soil; therefore one which has been recently cleared from wood is well adapted to the culture of it, more especially as it is supposed to be a great impoverisher of land. In such a soil it grows so luxuriantly that a hard or large spreading root will weigh nearly a pound. It is, however, remarked that what is produced from a clayey, tenacious soil shrinks less in scalding, while such as is raised in richer, free, black moulds loses considerably in that operation. The land intended for the cultivation of it is first well cleaned with the hoe, then slightly trenched, and planted about the month of March or April. It attains its full height and flowers about August or September, and fades towards the close of the year. When the stalk is entirely withered the roots are in the proper state for digging. This is generally performed in the months of January and February. After being dug they are picked, cleansed, and gradually seethed or scalded in boiling water; then spread out and exposed every day to the sun till sufficiently dried: and after being divided into parcels of about 100 lb. each, they are packed in bags for the market; this is called *black ginger*. The manner of scalding the roots is as follows:—A large pot or copper is fixed in the field or some convenient place, which is kept full of boiling water; the picked ginger, being divided into small parcels, is laid in baskets, and plunged in the water; where it is suffered to stay for the space of 10 or 15 minutes, and then spread on a platform for drying; but care is taken during the process to change the water so soon as it becomes much impregnated with the juices of the root.

"WHITE GINGER."

The white sort differs but little from the black roots. The difference arises wholly from the methods of curing them; the white is never scalded, but, instead of this easy process the 'roots' are picked, scraped and washed one at a time, and then dried; all which requires too much pains and time for any real advantage to be gained in the properties: though, being made more agreeable to the eye, the price of the white is much higher at market. When the root is intended for a sugar-preserve, it is dug while tender and full of juice (the stems at this time rarely exceed five or six inches in height), carefully picked, washed and afterwards scalded, till it is sufficiently tender: it is then put in cold water, and peeled and scraped gradually. This operation may last three or four days, during which it is commonly kept in water, and the water frequently changed for the sake of cleanliness as well as to extract more of the natural acrimony. After this preparation it is laid in unglazed jars and covered with a thin syrup, which in two or three days is shifted and

a richer put in: this is sometimes removed for a third or fourth, but more than three are seldom requisite. The shifted syrups are not lost, for in Jamaica they are diluted with water and fermented into a pleasant liquor called 'cool drink,' with some mixture of the chaw-stick, lignum vitæ, and sugar."—(LONG'S JAMAICA, p. 700.)

THE JAMAICAN METHOD.

MR. W. BANCROFT ESPEUT, F.L.S., writes regarding the curing of Jamaica ginger in 1886, as follows :—

"The method pursued in Jamaica is extremely simple. The ginger being about 10 months to one year old from the time of planting, and having arrived at maturity, begins to wither, the leaves getting yellow and shrivelled. The roots are then dug up, *great* care being taken not to *bruise* them. If the epidermis (skin) of the root is injured, it discolours the product. After the roots are dug, they are carefully trimmed with a sharp penknife and picked and allowed to dry in the air for a few hours until all the accompanying earth can be rubbed or wiped off with a soft cloth. The cleaned roots are then placed a few at a time in boiling water and scalded, and the epidermis is scraped off with a sharpened bamboo like a very narrow flexible paper knife. As soon as scraped they are placed in the sun until apparently free from dampness. Gradual drying results in a better product than quick drying. After this the drying is continued for a few hours a day in the morning sunshine and in air-drying sheds until after eight to 12 days the fingers break off sharp and clear. The ginger is then cured and should be sorted, all of one colour being kept separate, and the large again separated from the small. The water used in scalding should be clear and free from iron or excess of lime."

MR. J. H. HART also writes from the Botanical Department, Jamaica, in the same year as follows :—

"Jamaica ginger is cured in two ways, one in producing the commodity known as 'uncoated ginger,' the other 'coated ginger,' both saleable in British or American markets.

To produce the 'uncoated ginger,' which is that prepared for medicinal use, the fresh rhizome is simply scraped, washed and then well dried in the sun. When thus prepared it should have a pale, buff hue, a striated and fibrous surface, should break easily, exhibiting *a short farinaceous* fracture with numerous bristle-like fibres. It is often further prepared by bleaching, being subjected to the fumes of burning sulphur, or immersed in chlorinated lime. Much of that sold in England is coated with calcareous matter, either sulphate or carbonate of calcium. These bleaching and covering processes are, however, usually performed after the article reaches the first market.

'Coated ginger' is prepared by being dried in the sun without removing the epidermis, which causes the article to assume a crude and wrinkled appearance.

The rhizomes should be collected after growth is made for the season, which may be known by the leaves turning yellow and gradually drying up."

—JOURNAL OF THE BOARD OF AGRIC., BRITISH GUIANA.

POTASH CONTENT OF PLANTS.

MR A. BRUCE, Acting Government Chemist, has drawn our attention to the short note on Potash Content of Plants which appeared on page 215 of the March number. He points out that the figures quoted in this note are taken from a paper on Potash written by him and published in this Journal in July, 1915.

SOILS AND MANURES.

PRODUCTION OF PLANT FOOD IN THE SOIL.

E. J. RUSSELL.

It is now recognised that the plant takes up something of everything which is dissolved in soil water, quite regardless of whether the effect is going to be good, bad or indifferent. Even the most unlikely elements—gold itself and still rarer elements—have been detected in plants and have come in from the soil.

By long custom gardeners and farmers give the name plant food to those substances in the soil which help the plant to grow. I am retaining the expression in this sense, though it could be severely criticized from the physiological standpoint. Strictly speaking, the substances about which I am going to speak are not plant foods at all, but only the raw material out of which the plant builds up its food by a process infinitely wonderful and complex. But we shall avoid all ambiguity by giving our definition at the outset, and we can further disarm the criticism of the physiologist by inviting him to give us a better term that is equally simple.

We all admit the principle that we must be prepared to alter our vocabulary whenever the old terms would cause us to lose touch with the pure chemists and plant physiologists. But the changes in vocabulary of any one branch of science are now so rapid that one shudders to think what would happen to a borderland subject that tried to keep pace with two or three sciences. We may, therefore, be allowed to keep to our old words provided they convey a definite meaning to us, and that we make this meaning perfectly clear.

By plant food from the soil we shall understand those substances which the plant takes from the soil and which it utilizes in building up its tissues.

The plant food obtained from the soil is, roughly speaking, of two kinds:

(1) Substances already formed in the soil, which were part and parcel of the minerals from which it was derived.

(2) Substances not originally present, but which have come in since the soil was laid down as the result of the changes produced by vegetation.

Both of these are equally important, and both have given rise to a vast amount of research work. But each requires a different type of investigation, and so it has happened that each has been studied in different laboratories and under somewhat different conditions. The substances derived from the rock minerals, often called the mineral plant foods, including phosphates, salts of potassium, calcium, etc., have been studied in the main from geological and physico-chemical standpoints, while those resulting from vegetation have been worked at almost entirely from the biochemical standpoint. But the division line is only in the laboratory and does not exist in Nature; we shall see that all of the plant nutrients fall into each group.

The beginning of the soil goes back to remote ages when the particles of sand, grit, or clay got split off from the original rocks and began their

wanderings by stream, wind or glacier that have finally brought them to their present place. Many of their properties were determined during these wanderings and cannot now be altered; thus some of the most striking differences between the red soils of South Devon and the gray soils of Dorset arose out of the differences in conditions between Triassic and Lias times; these differences have persisted all through the ages, and we cannot now go back and undo the work of the past.

But the mineral particles do not constitute soil. The final stage in soil formation is not complete until vegetation has sprung up and died, and its remains have mingled with the mineral fragments and begun to decay. During its lifetime vegetation takes certain substances from the mineral matter and the atmosphere and builds them up into complex organic matter. Like other constructive work, this process requires energy, which in this case is derived from the sunlight and is stored up in the complex substances of the cell tissues.

When the plant dies and its remains mingle with the mineral fragments it begins to decay. The whole process then reverses: instead of a building-up there is a breaking down; the fabric of complex material slowly elaborated during life is disintegrated and resolved into the simple substances out of which it was formed, and all the stored up energy is dissipated. The old life is cleared away and the ground is left clear for new life; the old plant tissues are converted into food for another generation of plants. So prodigal is Nature with life that even this process of dissolution and decay affords the means whereby more life may manifest itself. A whole population of the most varied description springs up in the soil, feeding on these plant tissues, deriving its energy from the energies stored up during the lifetime of the plant, and reversing completely the changes effected by the plant.

SCHEME SHOWING HOW SOIL IS FORMED.

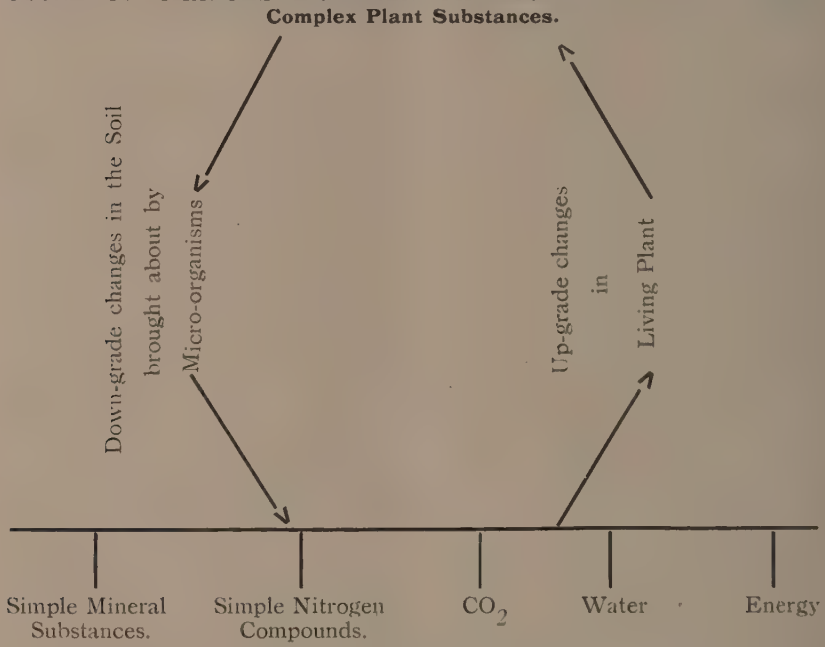
Mineral fragments	+	Plant Residues	=	Soil
[No energy]		[Organic matter comprising Carbohydrates (soft cellulose, gums, etc., Cellulose (resistant fibres, etc.,) Proteins Mineral substances Waxes]		[Comprising Mineral fragments Organic matter Sources of energy Micro-organisms]

So the cycle is completed. Starting with certain simple materials the plant protoplasm builds up complex plant substances, fixing the sun's energy by means of the transformer chlorophyll: this is the constructive part of the cycle. Later on, the other part—the destructive change—begins; the complex substances break down and are resolved finally into the simple substances with which the change began. Things are now as they were, excepting only that these simple substances have for a time been caught up in the wheel and have served for the manifestation of life; they have then been put down again, ready to serve as nutrients for a new generation of plants.

The soil is the medium in which this second part of the great cycle of life goes on. It is so intimately bound up with this cycle that one cannot separate them or think of the soil apart from the changes occurring within it. This is the great distinguishing feature of the soil, marking it off sharply from

a heap of mineral matter and bringing it out of the province of the mineralogist into the sphere of the biochemist. In the language of the laboratory the soil has to be studied as a dynamic and not as a static medium, and we have to think of it as the seat of perpetual change.

CYCLE OF CHANGES BETWEEN THE SOIL AND THE PLANT.



The process involved in the formation of soil may be seen at work on the little landslips that occur periodically on clay cliffs. With each new slip a new surface of subsoil is exposed as a heap of virgin mineral matter. Before long vegetation begins to spring up, frequently colt's-foot and equisetum. This dies down and starts the process of soil formation; finally a very different type of vegetation becomes possible. In order to follow the process more closely we have made at Rothamsted permanent beds of some of our clay subsoil, and have commenced systematic botanical, bacteriological, and chemical observations of the changes taking place.

The reverse process can also be seen at Rothamsted. A soil has been persistently cultivated for 71 years and all of the crop removed except the roots and the stubble: the organic matter and the energy supplies are therefore running out, and we are gradually approximating to the original condition. It is interesting that here also colt's-foot and equisetum flourish, although we hardly find them on our other plots.

The system we have to study is this mass of mineral particles intermingled with plant residues and living organisms; and our object is to trace the stages by which the decomposition proceeds and the energy runs down.

The first obvious change is that the plant material loses its green colour and grows black; this can easily be observed when leaves are dug into the soil or dragged in by earthworms. The old chemists were much interested in this black substance, and in the early days of the last century, when men

of science were very prodigal with new names for new forces and new substances, they supposed it to be made up of a number of compounds which they called ulmic acid, crenic acid, apocrenic acid, humic acid, etc. No one has ever succeeded in preparing any of these compounds in any state that would satisfy a modern chemist, and there is no evidence whatsoever that they exist; but their names have been piously handed down through long generations of students, and they still occasionally turn up in popular articles and in answers to examination papers.

So far this black material has defied analysis. Modern organic chemistry has been developed largely to deal with liquids and crystals; this black substance is neither, but is an amorphous glue-like body of the class known as colloids. Physical chemists in several countries are (or were) working at colloids, and we may yet hope to see some method of resolving them. The way out of such a predicament is to give the substance a non-committal name, and so we retain the old designation "humus."

Part of the humus is soluble in alkalis, and this was supposed naturally enough to be necessarily of more value in plant nutrition than the insoluble part; analytical methods were therefore devised for estimating its amount. It does not appear, however, that anyone has ever tried the fundamental experiment of testing whether the soluble part is really superior to the rest. *A priori* assumptions in our subject are particularly treacherous, and at Rothamsted the question has recently been under investigation. So far as present experiments have gone, the removal of this soluble humus has failed to make any appreciable difference to the growth of the plant, or to the physical and chemical properties of the soil. Further experiments with various types of soil would be necessary before pronouncing too definitely, but at present there is nothing to indicate that the soluble humus plays the controlling part in soil fertility formerly attributed to it.—Jour. of the Royal Hort. Soc.

MANURE AND ROTATIONS.

The following is the summary of Circular No. 8 on Manures and Fertilizers written by Frank T. Shutt, of the Dominion of Canada Department of Agriculture.

Rational farming is "mixed" farming, by which we understand the keeping of stock to consume a large proportion of the crops grown on the farm. Thereby the farmer uses animals as living agents to convert low-priced material (hay, roots, straw, etc.) into high-priced products which, sold to the city consumer, take from the farm comparatively little of the plant food of its soil and leave manure, the very best, the most valuable of all sources for economically maintaining and increasing fertility. Barnyard manure is unquestionably the most effective of all fertilizers.

Our chemical work has shown that the liquid portion of the manure is by far the more valuable, for it is not only richer in nitrogen and potash than is the solid, but these elements are present in a soluble and immediately available condition and can be at once utilized by crops. It is, therefore, the part of wisdom to use sufficient litter in the barns and stables to absorb all the liquid. If the supply of straw is short, sawdust and air-dried peat or muck may be employed as supplemental litter.

On the larger number of Canadian farms, the amount of manure produced is insufficient to keep all the land at its limit of production. We must, therefore, use it judiciously and to this end we advocate frequent light dressings, rather than larger ones at longer intervals. The manure is most advantageously applied for the root or corn crop in the rotation.

Although the constant aim should be towards deepening the surface soil—the chief feeding zone of our crops—this should be undertaken gradually, especially with naturally poor soils. In so far as this is brought about by manuring, we believe that it is not wise to "bury" the manure. A shallow ploughing under, or the incorporation by the means of the disc harrow, is for most soils and crops the most profitable practice.

Manure is never worth more for the general improvement of soils than when first voided. Since losses in humus-forming material and in the elements of fertility inevitably result from rotting; it follows that the sooner the manure is in the soil—its very best storehouse—the larger the return that may be expected from the farm's supply. Moreover, practical experiments conducted over a number of years have shown that for ordinary farm crops, fresh manure, weight for weight, has given yields almost equal to those from rotted manure.

The important part that manure plays in improving the tilth of a soil and in supporting the useful microbic life of a soil, has been well brought out, so that we can truly say that manure has a greater value than that indicated by its percentages of plant food.

Rational farming involves a rotation of crops; there are many excellent reasons to support this statement which we need not here enumerate or discuss. We would, however, emphasize the value from the manurial standpoint of the place of clover, or other legume, in the rotation. Laboratory investigations and practical field tests have alike contributed in proving the high manurial value of clover, alfalfa and other members of this family. Their growth adds much nitrogen to the soil and this in a form more or less stable and at the same time usable by subsequent crops. This nitrogen is appropriated from an inexhaustible source—the atmosphere, which is thus harnessed as it were to enrich our soils. The value of the legumes in this connection is emphasized when it is remembered that of all the elements of plant food purchased in fertilizers, nitrogen is the costliest. Further, the growth of the legume enriches the soil in humus-forming material, so that in many ways these plants are in a very real sense soil improvers. The lesson is then—grow a leguminous crop in the rotation, for thereby will not only much better valuable feeding material be produced but the land will be benefited. All other crops save the legumes leave the soil poorer for their growth.

Commercial fertilizers cannot be depended upon profitably to maintain fertility. Their exclusive use is strongly discountenanced. They are no substitutes for manure, yet they may frequently be employed as supplemental to it with profit, more especially if the crop be a high-priced one, as potatoes. Their function in rational agriculture seems to be to raise the proportion of immediately available plant food. They are altogether too expensive to be used for the general building up of a soil. Their use at first should be experimental, for it is almost impossible to foretell what profit may result.

Nitrogen, phosphoric acid and potash are the three elements furnished by fertilizers. Fertilizer ingredients are readily purchasable and mixtures

can be made without any expensive machine on the farm. By home mixing a saving of from 25 to 35 per cent. may be effected, and this course is advised on grounds other than economy, for it puts the farmer in possession of information respecting the nature of the materials, their functions and the proportions most profitable to use, that will be of much value for his future guidance. The text of this bulletin enumerates the various fertilizer ingredients on the market.

A fertilizer containing all three elements has, in the majority of instances, proved the most profitable. Large dressings have not, as a rule, given as large a profit as small applications, and the aim in experimenting with fertilizers should be to ascertain the minimum dressing for the largest return, or to put it otherwise, the maximum yield for the minimum expenditure. Profits rather than yields must be looked for.

The paragraph relating to special nitrogenous, phosphatic and potassic fertilizers should be closely studied, for the information therein contained cannot well be further condensed. Particulars are there given which explain the nature and function of these, and the amounts generally found profitable to apply are stated.

BACTERIZED PEAT.

The following is a summary of the experiments with Bacterized Peat or Humogen carried out by F. J. Chittenden :—

Bacterized peat is a preparation of bog moss acted upon by certain bacteria, and subsequently used as a culture medium for the development of nitrogen-fixing bacteria. The exact details of its manufacture are not divulged. On this account most of the experiments possible with it are of an empirical nature.

An endeavour was made to ascertain whether it had a stimulative effect upon growth, and three samples were received in 1914 and one in 1915, all from Professor Bottomley, and used in five separate series of experiments.

In Series 1, carried out indoors on various plants, the results were extraordinary and very uniform, growth being greatly increased by the use of the bacterized peat.

In Series 2, carried out in the open on three different kinds of plants, the results, while somewhat in favour of bacterized peat, were not what we had been led to hope for.

Series 3 was designed principally to see whether the somewhat dry summer was to blame for the comparatively small benefit seen outdoors, but on turnips the increase due to peat when ample water was available was only about 9 per cent. (nothing approaching that seen in the indoor experiments).

A comparison was also made as to the result obtained by the use of a light dressing of farmyard manure (20 tons to the acre), the peat being used in this series at the rate of 1 ton to the acre, and it was found that the farmyard manure gave in each case a heavier yield.

The experiments in Series 4 were inconclusive.

Series 5 was a partial repetition of Series 2 with another sample of peat in 1915. The increase obtained when peat was added to the soil was only 2 per cent., and when peat and lime were both added 5½ per cent., a result practically negligible, taking into consideration the cost of the application.

It is clear from our experiments that the full results are seen from the use of peat only when the supply of water is abundant, but the results in Series 2 and 5 were probably only slightly interfered with on this account, and in Series 1 and 3 this factor was eliminated.

The results on the whole show that when prepared under the best conditions bacterized peat is capable of acting as a very effective manure, but the meagre results obtained in the different series of experiments outdoors point either to a great variability in the composition of the different samples of the peat sent us, or to the action of some chemical constituent alone, possibly the nitrogen, the nitrogen being probably much below the quantity shown in the analysis quoted.

The report we are able to make on it applies merely to the samples with which our experiments were carried out, and there is nothing to show that other samples would give the same results.

It is also clear that if a sample could always be relied upon to be of the same quality as the first received the value of the material for plants in pots would be great, but it seems apparent that Professor Bottomley is still experimenting with the material and has not yet settled upon a fixed product or a fixed method of preparing it.

We are not informed of the cost of the prepared peat, and can therefore make no comparison of it from an economic point of view.*

DEEP TILLAGE.

Deep cultivation of the soil has been advocated for many years, and while it is practised to a considerable extent in large private gardens, it is very seldom resorted to in suburban and cottage gardens.

The interest in the cultivation of the sweet-pea has done much to disseminate the ideal of deep tillage, but there is still a large field for propaganda, and practical example. Deep tillage is healthy, invigorating, and, after practice, not unduly laborious. The man who does his own garden does not charge his labour against his crop, so he cannot urge the cost as an excuse.

The advantages of deep tillage are that a larger body of soil and plant food is placed at the disposal of the crop; the soil is more perfectly drained; air and water percolate through it more freely; garden refuse, harmless weeds,

* Since this report was completed the book referred to in the footnote on p. 311 has been published (*The Spirit of the Soil*, by G. D. Knox,), and we are there informed that the price has been fixed at £10 a ton for the time being, though it may be considerably less "when the substance is dealt with commercially" (p. 154). We are not told whether the cost includes carriage to the garden in which it is to be used or not—a point of considerable importance to market gardens, and to others who use large quantities of manure.

We are told also (p. 154) that the value of "the available plant food in peat, as compared with that in rotted stable manure, is as between fifty and eighty to one."

In the experiments in Series 3 described above (p. 315) we were able to compare the results obtained by dressing with peat (1 ton) with those obtained by the addition of 20 tons of farmyard manure which would cost delivered £8. In each case where comparison was possible farmyard manure gave a heavier yield than the bacterized peat which would cost more.—Jour. of the Royal Horticultural Society.

and manure may be more effectively buried, or incorporated with the soil; foul weeds are more easily eradicated; more moisture is conserved for the use of the plants during dry weather; and, finally, better crops are secured.

There is an annual controversy among gardeners as to whether it is advisable to bring the lower layer of soil to the surface, or after moving it by cultivation, to allow it to still retain its relative position. The contention on the one hand is that it makes for better cultivation, and brings the two layers of soil more quickly into one homogeneous whole, if they are turned bodily over. On the other hand, it is urged that it is unwise to bring poor soil to the surface, and bury that which is in a more fertile state. Both contentions are right as applied to different soils. The view here advanced is that it is desirable to have the whole mass of soil in the zone of cultivation of the same character and texture, that this can more quickly be obtained by bringing each layer in its turn under the influence of cultivation and exposure, but that where the lower soil is very poor, efforts should be made to enrich and improve it before bringing it to the surface.

Real trenching, which is to be preferred, means the inverting of all the soil for a depth of 2 ft. At one end of the plot a strip 2½ ft. wide is marked off, and the soil to a depth of two spits (or depths of the spade's blade) is dug out and wheeled to the part where the trenching will be finished. The exposed surface at the bottom of the trench is loosened with a fork. A further width of 2½ ft. is marked off and the soil is dug on to the open trench. The worker turns over one layer, returns turning over the other, and finally shovels out the loose earth, which is useful for levelling the newly turned ground. The bottom is loosened again, and the work proceeds until the last trench is filled with the soil originally taken out.

The other form, which is known as mock-trenching, differs somewhat. There a width of 2½ ft. is marked off at the end of the plot and the soil taken out one spade's depth, the loose soil also being wheeled to the point where the work will end. The soil at the bottom is deeply dug and broken, but left in the same position. Another width of 2½ ft. is marked off, and the top layer is turned into the first trench, and so on till the end. Here both layers of soil are moved and broken, but are left in their same relative position.

Deep tillage of this character should be undertaken at once in order that the soil may become settled somewhat by the time it is cropped. If possible, the whole garden should be so treated every year, and every effort should be made to have all vacant land trenched by the end of February.—The Times.

THE RESPECTIVE VALUES OF ORGANIC AND INORGANIC MANURES.

H. E. P. HODSOLL.

One of the results of the great increase in the use of artificial manures in recent years is that their variety has grown with the demand, and the question of their comparative values and peculiar properties has become one of some complexity and the same time of great importance to all interested in horticulture.

With the increase of motor traffic and mechanical transport the horse is fast disappearing from our streets. While this is a fact on which the general public may undoubtedly congratulate itself, bringing as it does quicker and more efficient transport and cleaner and healthier streets, yet to one class of the community—the market grower—the change is a serious matter. This is particularly so in the districts round London and the big towns where for generations stable manure—with perhaps, latterly, a little nitrate of soda—has been almost the only fertilizer used. Consequently its increasing scarcity is producing something akin to dismay in the mind of the grower, who is faced with the necessity of finding some other means of enriching his soil in order that he may maintain the standard of his production.

I want to show that the pith of the matter is the vexed question of the respective values of these two classes of manures, and that if we understood their action in the soil and in the plant it would greatly assist us in deciding what artificial to use for the purpose we had in view.

Unfortunately, although this question has long been the subject of controversy among scientists, it has received little practical attention at the hands of scientific investigators or the authorities in charge of our Experimental Stations and any evidence that we can obtain from the latter is therefore necessarily indirect and circumstantial.

First let us see what is meant by organic and inorganic manures. The former are those having an organic or living origin; that is, they are obtained from some living thing either animal or vegetable. Under this heading, therefore, we have farmyard manure and such artificials as crushed hoof, meat meals, bone stuffs, shoddy feathers, etc., from an animal source, and rape meal, castor meal, and green manures from the vegetable kingdom.

Inorganic manures are those having an inanimate or mineral origin, such as the mineral phosphates of various kinds, superphosphates, basic slag, nitrate of soda, sulphate of ammonia, and the mineral potash salts.

I want to discuss the relative merits of these two classes of manures and account for the superiority of the one over the other for certain definite purposes, in order that the user may judge for himself as to which will give him the result at which he is aiming.

The first thing that strikes one in considering this question is the very much higher price, especially in ammoniacal manures, that the user will pay—and has paid for years—for organic manures. For instance, in normal times the unit price of ammonia in crushed hoof or dried blood has stood at about 16*s*. or 17*s*., whereas the unit of ammonia in nitrate of soda or sulphate of ammonia has cost only 12*s*. to 13*s*. Why this preference? Most chemists and until quite recently the Board of Agriculture, have said that the value of these manurial units is the same whatever their source, the sole determining factor being their solubility. But organic manures are less soluble than inorganic, and should, according to this argument, be cheap instead of dearer.

It is obvious, therefore, that there is more in the respective merits of these two classes of manures than the holders of the mineral theory, as it is called, would have us believe. As A. D. Hall, one of the greatest of our present day authorities on the subject of manuring says, "The farmer has a strong preference, to which credit must be given as founded upon experience, for the organic sources of nitrogen."

Before going further into our argument it will perhaps be interesting to look at the results of a few of the Rothamsted experiments that bear somewhat on the point.

Table I shows an experiment carried out over a number of years with a view to ascertaining the comparative values of rape cake (organic), sulphate of ammonia, and nitrate of soda, (inorganic) as nitrogenous manures for mangolds. The complete minerals (superphosphate and sulphate of potash) were the same in each case. It would be seen that 4^C, the rape cake plot, shows a far higher average crop than either of the mineral plots, and further that the number of plants on this plot—a significant fact to which I shall refer later—is far in excess of these on either of the other two plots.

Table I. Effect of Manures on Mangolds.
(Rothamsted, 1876-1902.)

Plot.	Manures.	Average crop per acre.	Average No. of roots per acre.
		Tons.	Number.
4^C	Complete minerals with rape cake ...	21'3	17,474
4^A	" " with ammonium salts...	14'9	14,802
4^N	" " with nitrate of soda ...	18'0	14,130

Table II. shows the same experiment with farmyard manure added. Rape cake, it will be seen, is not only far superior to the inorganic ammonias, but gives a better result than farmyard manure in spite of the fact that the amount of nitrogen applied in the latter case is more than double that contained in the rape cake dressing. The moral of this is, I think, the value of the soluble form of organic over the insoluble, the ammonia in the rape cake being more available for the plant than that in the dung.

Table II.—Mangolds, Different Manures, Rothamsted.

Plots.	Manure.	Containing N per acre.	Average produce per acre.
4^N	Nitrate of Soda	86	17'95
4^A	Ammonium Salts...	86	15'12
4^C	Rape Cake	98	20'95
1^O	Farmyard Manure	200	17'44

Table III. shows the effect of the same three sources of nitrogen with different combinations of other manures. It will be noticed that the nitrate of soda plot beats that receiving rape cake when no potash is added; that is owing to the fact that, as is well known, soda liberates potash in the soil, and potash is very necessary for mangolds. The beneficial effect of soda in this respect, and its consequent superiority over sulphate of ammonia, are noticeable also in Tables I and II., and to a slight extent in the last two columns of this table; it is interesting, but has no direct bearing on the subject under discussion.

Table III.—Average Yield of Mangolds.

(Rothamsted, 32 Years, 1876-1907.)

	Superphosphate.		Dung.	
	No potash.	Potash, etc.	Alone.	With phosphate and potash.
Rape cake=98 lb. N ...	11·1	22·0	24·5	25·7
Nitrate of soda=86 lb. N ...	15·3	18·0	25·9	26·4
Ammonium salts=86 lb. N ...	7·5	15·2	22·5	24·0

When potash is added together with the superphosphate the rape cake again shows its superiority. The most interesting fact about this experiment, however, is that when dung is added the rape cake plot shows no marked increase, proving that the amount of organic matter present in the rape cake is almost sufficient for the crop, or in other words the humus required by the crop can be supplied by artificials alone, and that the addition of dung is not, as so many think, absolutely essential. This fact should reassure those who regard the increasing scarcity of dung with so much misgiving.

On the other hand, it will be seen that the nitrate of soda and sulphate of ammonia plots benefit greatly by the addition of dung, as it supplies the important ingredient, humus, that was otherwise lacking.

Table IV shows the relative yield of various crops from the use of superphosphate, basic slag, and bone meal as sources of phosphate. It will be seen that the longer the crop is on the land the better is the yield from bone meal, as in the case of wheat and swedes, whereas with shorter crops, barley and mangolds, it is not as good as that obtained from the mineral phosphates. This is due to the slower solubility of bone meal, and had a more soluble form of organic phosphate been used the superiority would undoubtedly have been more marked.

Table IV.—Relative Yield from various Phosphates.
(Rothamsted) Unmanured = 100.

Crop.	Superphosphate.	Basic slag.	Bone meal
Swedes ...	120	116	126
Barley ...	119	121	110
Mangolds ...	114	105	111
Wheat ...	106	108	117
Swedes ...	132	109	131
Means ...	118	112	119

The experiments of the Highland Society have also shown bone flour to be more successful than any other phosphatic manure for turnips.—

Journal of the Royal Horticultural Society.

Through Messrs. Cargills, Ltd., we have received from Mellin's Food Limited a copy of the 8th edition of The Care of Infants in India, a hand-book which has proved so useful to those who have the management of children born in the Eastern Tropics.

Snails lay their eggs in heaps of dead leaves, and these hatch out in from twenty-five to thirty days. In the State of San Paulo they are captured by hand, and the high-growing plants most subject to attack are surrounded by a rope of tarred piasava. Low-growing plants are sprayed with a 4 per cent. solution of copper sulphate, and pasture lands with a 1 per cent. solution of bay salt. Ducks and crows readily devour them. The glandinas, or carnivorous snails, will devour from fifteen to thirty of the pests a day, and have been successfully introduced into the south of France and into Tunis.

—C. H. H. in the Journal of the Royal Hort. Soc.

Man's hair-cut wastes and woman's combings are used as fertilizer. In Tokyo and suburb there are 3600 barber shops. According to the Principal Collector's information the amount collected is 25 bags of 125 lb —3125 lb. daily or 500 tons a year. Present price is Yen 1·70 per bag. Nagano province is the largest consumer. The wastes are esteemed as the best fertilizer for mulberry plantation. The barbers of Tokyo reserve the proceeds towards the expenses of their guild, funeral consolation and festival purposes. The collector's business good-will is said to be worth Yen 1000.—The Yokohama Nursery Co.

ENTOMOLOGY.

SPREAD OF INSECT PESTS IN RELATION TO THE AGRICULTURE OF CEYLON.

Since agriculture was exploited in Ceylon, it may be fairly stated that regulations for the prevention of the spread of pests, both insect and fungus, already established on various products, have been enforced in the case of two pests only—namely Shot-Hole Borer of Tea and Cocoa-nut Beetle.

The Ordinance and Regulations purporting to Shot-Hole Borer comprise certain clauses dealing with the registration of infested estates and punishment for neglect of that duty on the one hand, and, on the other hand, with the prohibition of the sale of tea plants from nurseries situated upon estates registered by the Director of Agriculture in the Ceylon Government Gazette.

During the past year, not less than one case has come to hand, where an estate has failed to register the presence of the insect, and not less than one case has been detected where a planter has sold tea-plants actually infested with Shot-Hole Borer to an estate uninfested by that insect. In no case has it been possible to take legal action, owing to the wording of the regulations in force. There can be no doubt of the fact that, had registration been strictly observed from the first, much might have been done to prevent the spread of Shot-Hole Borer to certain isolated districts, notably to estates in the Southern Province. It is not possible to prove legally that an infestation has actually passed from one estate to another, for the pest might previously have existed there unnoticed, so that any compensation which one planter may demand from another for neglect, has no legal basis.

In short, one planter is unprotected from his neighbour, not only in the matter of regulations and ordinances at present in force, but in view of any beneficial suggestion which may be put forward in future and upon which no strict legal supervision could be placed, were it even advisable to enforce the items of such suggestions by regulations.

In a completely organised community where all parts of that community are more or less on the same standing, complete co-operation in a beneficial project is at once desirable and possible, and it is one of my objects to explain to you how the planting community of Ceylon deviates from the ideal of a co-operative body with regard to plant diseases. First, then, I will deal with the question in connexion with certain studies I have made upon Shot-Hole Borer beetle of tea.

This insect is of peculiarly sedentary habit, for the female beetle, which constructs the gallery and deposits eggs in it, does not leave that gallery on any occasion during the development of the broods. When the female offspring emerge from the gallery, a considerable proportion attack that same tea-bush in which they were reared, whilst others fly or sometimes crawl to the nearest bush or other plant which they find suitable. The males, being wingless and extremely feeble, are positively incapable of this simple and comparatively slow method of self-distribution.

Nature has therefore compensated for this first by a rare and peculiar method of inbreeding, which prevents time being lost in the process of fertilisation, and secondly by so adapting the habits of the female beetle that it is able to produce the broods in various and widely-different species of plant. The adaptation of inbreeding may be compared with the occurrence of parthenogenesis, i.e. the development of eggs without intervention of a male sex, as in Stick-insects, and Gall-forming Hymenoptera (Gall-flies) and certain generations of Aphids (Green-fly) and scale insects, whereas the adaptation to gallery-construction in various plants is directly comparable to polyphagy, i.e. a condition in which an insect, originally confined to one host-plant, becomes adapted to feeding on one or more different species of plant. These two conditions are well known to account directly for the rapid spread of insects such as the Gipsy Moth, the powers of locomotion of which are very limited in the case, here, of the female sex, but in which the rapid, devastating increase has made itself too apparent.

The only other natural means of distribution through increase is due to migration in swarms of which I have no sign of a definite record for true Shot-hole Borer of Tea : when swarms have been noticed and the insects sent to me for identification, the insect in question has always been of a completely distinct species or even genus. Physical conditions conducive to the Spread of Shot-hole Borer over long distances centre themselves in the strong winds which prevail in definite directions at known seasons of the year.

It is my experience that, given similar altitudes, wind-swept tea-ridges are subject to heavier attack than more secluded and sheltered spots, but there must be many who hold opposite views, based upon long periods of observation.

A very large number of accurate records are necessary to establish any reliable solution to the problem of distribution by wind, and it must be universally agreed that the case might well be completely inverted by composition of soil and health of the tea in question. At any rate if the insect is carried great distances by wind, it follows that a large number of wind-belts planted up would do much to retard infestation from this source, and I have excellent grounds for belief that distribution by wind is limited in all cases to a very small number of individual beetles only.

To plant thick wind-belts so as to divide off certain *districts* from one another in relation to wind direction would not, however, be beneficial to any proportionate degree, owing to the great differences of elevation which exist within limited areas.

The mechanical means, which account for a rapid spread of Shot-hole Borer, lie in the removal of infested tea-stumps and plants from one area or district to another; a matter which it is quite unnecessary to dilate upon, and which has undoubtedly been one of the main causes of the spread of the pest. The removal of firewood from estate to estate is of no particular importance; the wood is mostly Grevillea, and a most careful study has been made of the beetles which make holes so suspiciously like the entrance-hole of Shot-hole in this wood: these belong to two species of Scolytid completely distinct from the species under consideration.

I must, before leaving the question, say that it is hardly possible that true Shot-hole Borer should be carried by any means other than in the plants which they attack freely.

Having reviewed the means by which Shot-hole Borer becomes distributed, it would be well to make some reference to two other insects which are injurious to tea and now in course of more or less rapid increase. The first is Tortrix, a moth which was first observed on tea in Dimbula district in the year 1899. It is now found in Dimbula, Maskeliya and Hatton districts as a very severe pest, and has fairly recently made its appearance in Nawalapitiya and Dolosbage. The second is a small species of Shot-hole Borer, *Xyleborus compactus*, which was found affecting tea in Ceylon in the year 1913 at Wattegama. Kandy, and in 1914 in Halgranoya. I have now found it during the past year in tea in the Southern Province and in tea-stumps sold from an estate in Halgranoya to an estate in Haputale. In the latter case the stumps were luckily destroyed immediately and the distribution definitely checked.

It is hardly within my province to dilate upon Fungus pests, but mention may be made of *Hemileia vastatrix*, the coffee pest—the deplorable effect of which can never be forgotten in the Eastern hemisphere. In 1869 the fungus appeared on a few coffee plants in Madulsima. In 1873—five years after its appearance, not a single estate was free from it, and in 1882 coffee was no longer a staple product of the Island.

The life-history of the fungus was described between the years 1878 and 1882 by MORRIS, DYER and MARSHALL WARD, but no practical remedies were forthcoming in time to save the industry.

It has been repeatedly pointed out by Entomologists and Mycologists alike that large areas under cultivation of one product are subject to rapid devastation by disease, and true though this is, it still remains to be seen what conditions of cultivation bring the constitution of a plant into such a state which subjects it to ravage of disease. One can form a fairly clear idea in the matter of tea, which for the past 25 years has been subjected to the severest forcing systems possible in hard plucking, and frequent pruning brought on by a headlong rush to squeeze every ounce of revenue out of the luckless bush, now situated in the majority of districts on a soil far from congenial to any kind of vigorous growth.

A comparison between coffee grown naturally and that subjected even to a light system of pruning has shown a marked difference in its resistant power to *Hemileia vastatrix*, and I am able to announce quite definitely that the same is the case with tea seed-bearers, which, in proportion to the surface of the tree subject to attack, are infested by Shot-hole Borer to an amazingly small extent, in comparison with bushes which have been pruned and plucked regularly for long periods.

To a certain degree this forcing system must continue and cannot be altered, and accordingly the industry can be protected only by checking and preventing the spread of disease in its earliest stages. We have a huge area of tea practically undivided by any other kind of plant growth, a condition which is admirably favourable to still more rapid spread of disease.

The only counteracting medium would be either the presence of a labour force in Ceylon which could easily and cheaply be put into quick organisation to carry out remedies recommended, or a co-operation amongst planters on the various estates of the Island to effect the same ends.

In view of this, then, I wish to review as briefly as possible, the position of estates in relation to control of a special pest—namely, Shot-hole Borer of Tea.

It will be quite unnecessary to mention the actual name of any estate,

for the conditions which I must hold to view apply to the community in general, and it is not for me to set myself up as a critic upon the management of estates, when criticism is unnecessary and conditions unalterable.

A successful outcome to the riddance of Shot-hole Borer as a pest—an outcome which is, if I am permitted to say so, growing gradually into the form of tangibility—cannot be carried to an end by a wave of the hand. It requires first, labour; second, expenditure; and third, co-operation; the latter only in as far as conditions stand at the moment.

On no small number of estates the size of a labour force is such as forbids definitely the carrying out of any practices other than those essential for the production of leaf, with accessory processes compatible with a profitable return for the amount spent in manufacture.

On fewer estates, the labour force is not large enough to cope with the area of land under cultivation, so that tracts of waste tea make their appearance.

Again, some estates are for one reason or another disliked by the constituents of a labour force, resulting in uncertainty as to the size of that force at any given time.

Last, during a drought, or in certain periods of the year, much inconvenience is caused by a lack of work to satisfy the members of the labour force, so that many hands are, at the time, lying idle, especially as regards the male sex.

While the latter estates are eminently suited to control pests, during periods of labour inactivity, all those mentioned in previous categories are quite incapable of expending time or money upon matter not actually pertaining to profitable returns, or to making both ends meet. Were it possible to bring in a socialistic scheme in Ceylon, in which all estates were on the same footing financially, then it might be possible to meet some of the exigencies set forth, but such a scheme is as absurd as it would be unprofitable.

So, there are some estates which can, and some which cannot, use a labour force to control pests, and as the former may actually be contiguous to the latter, or vice versa, the question of wholesale control of pests becomes impossible, for so soon as one estate has eradicated that pest or taken steps for its control, the pest in question spreads back on to that estate from its neighbour.

The matter of expenditure can be dealt with in a few words. The financial status of many estates is not such as allows of a special labour force being employed at a particular time. It is, of course, easy to lend labour in slack periods, but some estates cannot afford it, and the application is to some estates and not to all.

Co-operation is undoubtedly the best means to any end, and in the control of insect-pests would be possible in Ceylon, were it not for the irregular distribution of labour and, further, for widely different variations of climate and conditions of cultivation produced by climate in the tea-growing area. If co-operation is impossible, and it clearly is, then isolation must be resorted to, and isolation, it can be shown, is neither impossible nor necessarily unprofitable in comparison with the benefits to be derived from it.

It cannot be in the interests of a community for one portion to carry out extensive operations against pests, while the other, from which it has no protection, is prevented from doing so by unalterable circumstances.

In connection with this it is suggested that belts of trees be planted between all estates as a means, not only of checking further spread of shot-hole borer, but of other diseases, both insect and fungus, which are making their appearance. It is not to be maintained that such belts could in

any way provide a strict and permanent protection, but when the tea of one estate adjoins without break the tea of another under different management, temporary protection for a considerable time would most certainly be afforded, and would allow of an expert being summoned to study the pest before the area of distribution had become so great as to make investigation into control measures a matter of several years.

The scheme, then, is to plant up a belt of vegetation where an adequate tract of the kind is not already situated, between such estates as converge closely upon one another, and encircling all estates where tea is existent at the present time, irrespective of proximity to neighbouring estates.

It is suggested that these belts should be 30 feet in width and consist of closely planted trees, which could form a lasting and stable screen, supplemented by an undergrowth of considerable denseness.

An undertaking on so large a scale as this requires serious and careful consideration : the importance of it cannot be fully realised until the *pros* and *cons* are weighed against each other.

I have endeavoured to set out the argument for the scheme, and it remains for you to decide whether the benefits to be derived would be proportionate to the loss of a few rows of tea on certain parts of the many estates of the island and the expense of planting up the belts. The exact nature of the belts would be decided by the opinions of experts on tree-planting and with regard always to the question of choosing vegetation least subject to harbouring and transmitting disease. Some minor problems will have to be dealt with when roads run from one estate into an adjoining one and doubtless other small points will require consideration.

In conclusion it must be said that two scientists have already brought up the idea in past years. Both these were Mycologists and not Entomologists.

In what connection CARRUTHERS advocated the scheme I am unable to trace, but MARSHALL WARD in 1881 gave it as one of the only suggestions for the control of coffee leaf disease. It can only be hinted that the case was not backed by suitable weight of fact, and was thus, with the extinction of coffee, passed over apparently with complete indifference, and without arousing the deserved consideration commensurate with its significance.

E. R. SPEYER.

DISCUSSION.

At the conclusion MR. WILKINS remarked that with regard to MR. SPEYER'S proposal for tree-belts to be planted as a preventive precaution he knew of several cases of isolated tea estates surrounded by jungle 5 miles wide and yet had both the Borer and the Tortrix.

MR. SPEYER replied that the jungle of mixed trees very often contained borer but that these belts should only contain trees known to be immune from attacks such as *Acacia decurrens*.

MR. HUYSHE ELIOT said that some years ago the advisability of allowing belts of unpruned tea-bushes to grow up between estates was discussed and he understood from MR. SPEYER that such bushes and seed-bearers were not so liable to borer attack, the leaving of belts of tea might be worth considering.

MR. SPEYER said this would not really break up the large tea expanses which was the object in view.

MR. MACMILLAN said that in the Malay States and New Guinea Government only sold land on the condition of belts of forest being left at intervals.

The CHAIRMAN hoped members would seriously consider this question of tea belts, which it was thought should be 30 feet wide.

SERICULTURE.

SERICULTURE IN SOUTH INDIA.

T. V. RAMAKRISHNA AIYAR, B.A., F.E.S., F.Z.S.

(*Acting Government Entomologist, Agricultural College, Coimbatore.*)

THE ORIGIN AND GROWTH OF THE INDUSTRY IN SOUTH INDIA.

The origin of the silk industry in South India may be traced back to the second half of the 18th century. It is said that Tippu Sultan, the then ruler of the province of Mysore, was the first to introduce the art into South India. It appears he specially sent a native of Trichinopoly to study the silk industry in Bengal and had mulberry plants and silkworms brought to Mysore. That Tippu had made a beginning in this direction is also evident from the pages of DR. BUCHANAN.* The methods adopted and the appliances used in the silk rearing localities of this part of India also tend to show that the industry might have been introduced from Bengal. From the very days of its introduction into Mysore, silk rearing has been in existence in the different parts of this state and though it has not made any improvements, it is to some villages in this province that we have to look for the best and well known silk centres of South India. During the closing years of the 18th century and in the beginning of the next, attempts at introducing the industry into the different parts of the Madras Presidency were strenuously made by the British Government. The East India Company encouraged the art by starting experiments on its own initiative and also gave help to private individuals. Prominent among those who evinced a keen interest in the matter and worked a good deal to spread the industry was DR. JAMES ANDERSON of the East India Company. The experiments carried on by the latter under the supervision of DR. ANDERSON in the different selected localities of the presidency and the results that followed are clearly detailed by GEOGHEGAN.† Very little success, however, seems to have attended these attempts and we hear nothing of any fresh trials in this direction until we come to the early eighties. In 1882-83 the Government of India‡ took up the matter and distributed mulberry cuttings and silkworm seeds to the various provinces for trial. In Madras the experiments were chiefly conducted at Saidapet and the Central Jail at Coimbatore. Though the trials proved more or less successful no further attempts were made by Government since then to introduce and develop the industry in the different parts of the presidency.

Excepting in the province of Mysore, at the present day, sericulture exists on a commercial scale only in two of the taluks of the Madras Presidency§, viz. Kollegal in the Coimbatore District and Hosur in the Salem District. In the former the industry is carried on on a fairly large scale all

* BUCHANAN's Travels in Mysore, Canara and Malabar in 1800—1801.

† Some account of silk in India by J. GEOGHEGAN published in 1880.

‡ For the account of these trials refer to LIOTARD's Memorandum on Silk in India, part I., published 1883.

§ Mysore not included.

over the taluk: while in Hosur, though silk rearing existed here and there some decades ago,* it is now confined to Berigai, the head quarters of the Berigai Zamindary. There is little doubt that the industry must have found its way into these tracts from Mysore. We have hardly any evidence to show at what particular period in history the industry was introduced into these British Taluks. The following sentence, however, in the Salem Settlement Proclamation of CAPT. READ, one of the earliest Collectors of Salem, issued in 1796 tends to show that mulberry growing and silk rearing might have existed in this tract a few years previous to this Proclamation. "The company being desirous to introduce the manufacture of silk and other valuable productions, only one sixteenth of the ordinary rates of *Tirwa* will be required for lands growing mulberry, etc."

Both Kollegal and Hosur situated as they are along the borders of Mysore, share with the latter, the greater part of the physical features, climate and local conditions. With an average elevation of from 2,000—3,500 feet and a sub-tropical climate, these two upland tracts have been found well suited to the growth of mulberry and the cultivation of silkworms. To hand down this industry from the days of its introduction into these places to the present day without allowing the same to die away, these two places not only possess the necessary physical features, but have been enjoying the advantage of the proximity of the big silk centres of Mysore such as Maddur, Closepet, Chennapatna, Bangalore, etc. Thus sericulture at present exists only in Kollegal and Berigai in the presidency, and the account of it given below is chiefly the result of the observations and study made in these two localities. In Mysore silkworm rearing is carried on on a much larger scale in different parts of the state, and so far as I have been able to make out from what I saw at Maddur, Closepet, Chennapatna, Malavalle and some of the Mysore villages adjacent to Kollegal, there are no differences in the rearing methods, mulberry growing, silk reeling, etc., between the Kollegal and Mysore silk farmers and so the following account might apply to a great extent to Mysore as well.

THE SOUTH INDIAN SILK WORM.

The 'Mysore silkworm' as this insect is popularly known is one of the mulberry feeding varieties. It belongs to the family of lepidopterous insects (Moths and Butterflies) called *Bombycidæ* which includes all the mulberry feeding silkworms and a few others which are of very little importance as silk producers. This insect is thus different from the other silkworms such as the eri, tasar, muga, etc., all of which fall under a separate family called *Saturniadæ* and feed on various other plants. The mulberry feeding worms of different kinds all group themselves conveniently into two classes, viz., those that are 'Univoltine' and those that are 'Multivoltine.' Univoltine silkworms are those which pass through only a single generation in the year and as such yield but one crop of cocoons. Multivoltines on the other hand pass from two to eight generations every year and produce as many crops of cocoons. The silkworm *par excellence*, *Bombyx mori*, which is the best silk producer, is an univoltine worm and is the one extensively cultivated in many European countries, China, Japan, Turkey, etc. It thrives well only in places with a temperate climate and gives the finest cocoons. This worm is also

* *Vide* LE FANU's Salem District Manual, 1883.

reared in Kashmir. The eggs of this insect remain in that stage for nearly ten months in the year and require a colder temperature for a uniform hatching. It is believed that all the mulberry feeding worms, whether univoltine or multivoltine, have descended from *B. mori* and many of them have acquired different habits and features through ages of domestication and adaptation to different grades of climatic and other conditions. In India the bulk of the raw silk is produced by three or four multivoltine varieties reared chiefly in Bengal. The silkworm cultivated in Southern India is also a multivoltine race and passes through six or seven broods in the year. This insect has been identified as *Bombyx** *meridionalis* and some experts are of opinion that this worm and the *Chota Pal* or *Bombyx** *sinensis* of Bengal may be the same. It is also believed that it was this China worm, *B. sinensis*, that was first introduced into Mysore.

LIFE HISTORY OF THE SOUTH INDIAN SILKWORM.

The parent silk moth lays from 250-400 eggs. Each egg is minute in size, oval in shape and looks like a seed. Across the long axis it measures 1 ¼ m.m. and across the short it is 1 m.m. There is a gentle depression on the upper surface. In colour the eggs are cream to yellowish white when laid, but just before they hatch out into worms they get a bluish black colour, this being due to the dark embryo seen through the transparent egg shell. It generally takes ten days for the eggs to hatch; but this period may be shorter or longer by two or three days according as the weather is warm or cold. They do not all hatch at once or at a particular hour of the day, but continue hatching out all day. The just hatched worm (Canarese—*Hula*, Hindi—*Kida*,) is minute in size, being only 2 m.m. long. The body is slender and more or less cylindrical. It is fringed at this stage with tufts of fine hairs each tuft rising out of a minute tubercle. There is a ring of such tubercles around each segment of the body. The colour is dark brown; the head is black and the thoracic region dorsally has a lighter shade of colour than the rest of the body. The future post median horn is at this stage in the form of a small swollen tubercle. Similar to many other insects the worm moults periodically as it feeds and grows. Four such moults are passed before the worm begins to spin the cocoon. Each of these moults is known among silk rearers as a fever (Can.—*Jwara*, Hindi—*kalef*) probably on account of the inactive condition in which the worm remains during the moulting stage. The rearers—both in Kollegal and Berigai—also understand the meaning of the moult and often compare it to that of a snake. The first moult occurs 4 or 5 days after hatching out from the egg and the subsequent ones follow at intervals between four or five days of active feeding. After the fourth moult the worm continues feeding for a week or ten days without stopping and at this stage just before it spins its cocoon, it is called a "fruit" (Can. *Hannu*). As it grows from a small worm to this stage it gradually gets a pale white colour and just before spinning a tinge of transparent yellow is also added. A full grown worm is two inches long. The head is more or less orbicular and of a slightly different colour from the body. The spiracular slits are clearly seen along each side as brownish dots. The post median horn is also prominent.

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* Both of these are only races of *B. Mori*, not distinct species. Interbreeding readily takes place.

The silkworm rearers of Kollegal and Berigai recognise two different kinds of worms and this distinction is said to be clear only when the insect is in the worm stage just after the 2nd or 3rd fever. The two kinds are *Bóll hula*† or *Bodi kida** and the *Basavant pad hula*† or *Nami kida*. The only difference between the two forms consists in the latter kind possessing some dark hoof-like spots on the body on the dorsal surface. In all other respects the two are similar, though some rearers assert that the spotted kind yields bigger cocoons but does not resist climatic variations easily. But sericultural experts are of opinion that there is only one variety in Southern India. The feeding stage in the worm's life extends from thirty to thirty five days according to the season, being shorter in summer and longer in winter. The ripe worm is transferred to the cocooning frame and here it builds the cocoon. Within 24 hours the cocoon is finished.

THE COCOONS.

The cocoons of this silkworm, called *Gudu* in Kanarese and *Nāpha* in Hindi, have a bright yellow colour with a tinge of green. Though inferior to the cocoons of the European silkworm in every way, these are said to be of a better quality than the Bengal cocoons. The fibre length of a Bengal cocoon ranges from 200-250 yards, while that of the South Indian worms is on the average 300 yards. That these cocoons are superior is also gathered from the fact that a great quantity of them is exported from Kollegal and other places in Mysore to filatures in Bengal. This is due to the fact that the Kollegal people cannot reel properly. Filatures were set up in Kollegal and closed down on this account. An average sized cocoon measures 30 m.m. across the long axis and 17 m.m. across the short axis. Thousand fresh cocoons of average size in Kollegal weigh three local seers or about two pounds in weight. The insect remains inside the cocoon for from 10-12 days—very rarely it is two or three days more when the winter is severe. At the end of this period the winged moth emerges out of the cocoons. The male moth (*Kan*—'Gendu chitta') is smaller than the female (*Kan*—Hennu chitta'), the former measures 15 m.m. and the latter 20 m.m. in length from head to tip of abdomen. Both have the wings developed, but they never fly. The whole body in the moth is of a white colour. The wings in addition have some dark brown markings. The front wing has a pale dark semi-lunar band across the proximal region and another band parallel to the outer margin across the distal end. The wing expanse extends 40 m.m. Mating takes place the same day after emergence and after 24 or 36 hours eggs are laid. Thus the average period of each stage in the life of the silkworm is as below.

Egg . . .	10—12 days.	Pupa or cocoon . .	10—12 days.
Worm.	30—35 days.	Moth	1— 2 days.

The whole cycle extends at this rate from a month and a half to two months on the average and six or more generations are passed by this worm in the year.

(To be continued.)

* Synonym in Berigai.

† Names used in Kollegal.

S. A. SILK CAMP IN CHANGA MANGA MULBERRY FOREST.

(Communicated.)

A MULBERRY FOREST.

Perhaps the only Mulberry Forest in the world is to be found at Changa Manga near Lahore. It is some 10,000 acres in extent, and has hitherto only been used for purposes of fuel and timber. It demonstrates that mulberry can be profitably grown by Government and private individuals for fuel and timber purposes, apart altogether from its great value in providing food for Silkworms.

A SILK CAMP.

Some months ago Commissioner Booth-Tucker of the Salvation Army asked the permission of the Punjab Government to take advantage of the immense supply of foliage in this Forest to establish an annual Silk Camp during the months of February and March for the rearing of Silkworms on a large scale, with a view to popularising the industry throughout the Punjab and other parts of India, and in order to demonstrate the best methods for rearing Silkworms.

His Honour the Lieutenant-Governor expressed his cordial approval of the scheme, and 5 acres have been assigned within the forest for the purposes of the Silk Camp.

Operations were commenced early in January when a party was sent in advance to make the preliminary arrangements for erecting sheds and preparing accommodation for some two to three million silkworms.

As far back as May, 1915, a supply of disease-free eggs of the best varieties had been ordered from Europe. They reached the Simla Silk School in October, and were there hibernated in a special machine provided for the purpose.

HIBERNATION OF EGGS.

This important preparation for the silkworm industry is of recent introduction, but is an important link in the successful rearing of the best varieties. It helps to ensure a vigorous race of worms, who will produce cocoons rich in silk, and also protects them from disease.

HATCHING THE EGGS.

This again is another important link. Special hatching machines of a simple pattern have been utilised by the Salvation Army during the last three or four years. The use of these and their value for hatching purposes will be demonstrated. They insure uniform heat, and enable the eggs to hatch out simultaneously, thus avoiding much trouble, delay and loss of eggs from chills.

HOUSING WORMS.

Different systems will be demonstrated in the Silk Camp. The two chief dangers to be guarded against are excessive heat and excessive cold, with violent variations between the two. The various systems will be demonstrated and the students, workers and visitors will be allowed to judge for themselves which they consider best, or which will be most suitable for their own locality.

One large shed has been prepared on a system which guards both against cold and excessive heat. This has been introduced with great success at The Salvation Army Silk farm in Moradabad. A trench is made about 100 feet long and 12 feet broad and 3 feet deep. The excavated earth makes a wall about 3 feet high, with a thick thatched roof, and a doorway at each end. In a dugout of this character worms have been successfully reared in the hot weather.

The Persian system of a shed on poles raised above ground, where the air can freely percolate all round and leaves can be stored underneath to get rid of extra moisture when there has been heavy rainfall, will also be demonstrated.

In Japan and Europe it is usual to rear the silkworms on shelves, carefully arranged, tier on tier. This economises space and gives the worms the best individual care. In Kashmir and most parts of India, the worms are usually reared upon the ground, branchlets of Mulberry twigs being heaped on top of each other. This ensures economy of labour, an important consideration. Instead of 6 or 7 feedings during the 24 hours, only two are necessary,—morning and evening. The respective advantages of both systems will be demonstrated.

THE CAMP.

Besides the large sheds for the hatching of the worms, there are more than 50 tents for the accommodation of the workers and the staff, and for lectures and demonstrations. The Camp is already a hive of industry, with about 100 workers. It is intended to increase the number to 150 as the worms increase in size and need more attention.

VISITORS TO THE CAMP.

A good many distinguished visitors are expected. These will include His Honour Sir Michael O'Dwyer, the Lt.-Governor of the Punjab, and the newly appointed Silk Officer, Professor Maxwell Lefroy, who is conducting an investigation into the Silk Industry for the Government of India.

VILLAGERS, SCHOOL TEACHERS AND CHILDREN.

It is also hoped that the Camp will attract a constant stream of villagers and school children from the surrounding neighbourhood. They will be allowed to take away a small supply of worms to their own homes, and the cocoons which they produce will be bought from them, and a careful list kept of the best rearers for future use.

LOCAL GOVERNMENTS AND INDIAN STATES.

It is hoped that Local Governments and Indian States will send their representatives to study the Silkworm Industry at close range with a view to introducing it in their own localities. Thus an impetus will be given to the industry over the whole of India.

THE PRESS.

It is also expected that the Press, both English and Vernacular, will send their representatives and make known through their columns the advantages of an industry which provides to Japan, China, Persia, Syria, Hungary, Italy and France such an immense revenue, trickling down to the humblest cottages of the poor.

UNIQUE IN THE HISTORY OF SILK.

Never in the history of the silkworm has such a unique Camp School been established, for the simple reason that nowhere else in the world does such a forest exist. It is hoped that in a few years, with such a practical demonstration before its eyes, mulberries will be planted and silkworms raised on such a vast scale as will enable India to take its rightful place amongst the silkworm growing countries of the world.

GENERAL.

CEYLON AGRICULTURAL SOCIETY.

MEETING OF 29TH FEBRUARY, 1916, AT JAFFNA.

Minutes of a meeting of the Board of Agriculture held at the Jaffna Kachcheri on Tuesday the 29th February, 1916.

There were present:—THE DIRECTOR OF AGRICULTURE, GOVERNMENT AGRICULTURAL CHEMIST, GOVERNMENT ENTOMOLOGIST, MESSRS. T. H. PARSONS, ST. L. H. DE ZYLVA, J. S. DE SILVA, G. J. HULUGALLE, N. WICKREMARATNE, MUDALIYARS J. A. WIRASINGHE, W. A. EKNELIGODDE, A. E. RAJAPAKSE, PROCTOR KRISNARATNE, J.P., U.P.M., MR. K. BANDARA-BEDDEWELA, AGRICULTURAL INSTRUCTORS KARUNANAYAKE, MADANAYAKE, L. A. D. SILVA, J. R. NUGAWELA and A A. JAYASINHE, Members of the local Tobacco Committee, MESSRS. HEW KENNEDY, B. F. SCHERFFIUS, MUDALIYARS RAMALINGAM, RASANAYAGAM, P. C. NICHOLAS, SIR WILLIAM TWYNAM, MR. S. WADHIA, HON'BLE MR. A. KANAGASABAI, PROCTORS V. CASIPILLAI, T. C. CHANGARAPILLAI, T. SIVAKOLONDU, S. KANDIAH, S. TAMBIAH PILLAI, ADVOCATE RAJAKARIAR, REV. A. A. WARD, DR. W. CHINNIAH, MUDALIYAR C. M. SINNAYAH, MR. A. SABAPATHY, MR. A. CANAGARATNAM, MANIAGARS V. M. MUTTUKUMARU, J. N. SANDRASAGARA, C. MUTTUCUMARASWAMY, K. CHINNATAMBY, MUDLR. A. CHITTAMPALAM, A. CANAGASABAI, S. CHELLIAH, V. CHELLIAH, R. R. B. KUMARAKULASINGHE, P. RAJAGOPAL, MESSRS. A. SARAVANAMUTTU, W. RATNAGOPAL, M. SWAMINATHAN, H. T. TAMBIMUTTU, W. M. MUTTUVELUPILLAI, N. SELLATURAI, J. RODRIGO, S. PONNASAMI, S. SELVATURAI.

The Committee of the Board with the Director of Agriculture in the chair met at 2'30 p.m. and discussed the applicability of dry-farming to coconut cultivation in the North, and it was decided to establish a trial plot close to Pallai.

The meeting of the Board followed, with MR. B. HORSBURGH, the Government Agent, in the Chair.

The following resolution was passed before the proceedings commenced:—"That the Board of Agriculture records its deep regret at the death of SIR HECTOR VAN CUYLENBURG, who was a member of the Board for four years and rendered valuable service to Ceylon in the cause of agriculture especially as affecting low-country products, and desires to express its condolence with LADY VAN CUYLENBURG in her bereavement."

The Secretary read the minutes of meeting held at Galle on 30th November, 1915, which were duly confirmed.

Progress Report for the quarter ending February was adopted, of which the Secretary read the more interesting extracts.

Statement of Expenditure to end of January was tabled.

The papers on "Curing and Fermenting of Tobacco" by MR. SCHERFFIUS and "Cattle Insurance" by MR. N. WICKREMARATNE were taken as read.

The CHAIRMAN welcomed the society to Jaffna and referred to the fact that it had an intelligent body of cultivators to work among in that they had a good knowledge of rotation of crops, manuring, tillage, etc. He expressed the hope that the Tinnevelly tobacco farm would be continued beyond the proposed period of 3 years so that definite results might be obtained. He also referred to the School of Tropical Agriculture and trusted that it would soon develop into a College.

Various questions arising out of the report were answered by the Director, the Secretary, Mr. Bamber, and Mr. Hullugalle.

Mr. de Zylva, Registrar of the School of Tropical Agriculture, who was present, spoke about the work being done by that Institution.

At the conclusion of the meeting Mr. V. M. Muttukumaru, Maniagar of Jaffna, handed the Secretary a list of 13 names of new members recruited in Jaffna.

Peradeniya, C. DRIEBERG,
1st March, 1916. Secretary, C.A.S.

FLOWERING SEASON AT PERADENIYA.

[*Illustrated. See Frontispiece.*]

The question is often asked: What is the best time of the year to see Peradeniya Gardens? The answer must obviously be qualified in accordance with the object in view or special desires of the inquirer. Smooth green lawns and a display of flowering or bright-foliaged perennials or annuals can usually be seen at their best from August to October, while the chief season for orchid-flowering is April to May, unfortunately a period when, for climatic reasons, fewest persons visit the Gardens. To miss visiting Peradeniya, however, in the months of February to April is to miss seeing some of the most gorgeous floral displays which the vegetable kingdom produces in the tropics, more especially in regard to trees and climbers.

BOMBAX MALABARICUM,

or Red Cotton Tree, is the well-known, but nevertheless handsome, gigantic malvaceous tree which may be said to open the first flowering season in the year. It begins in real earnest by throwing off its coat, as tropical trees sometimes do, i.e. completely defoliating, then puts on a mantle of large scarlet fleshy flowers which render the tree a distinguished landmark for a considerable distance away. It continues in blossom for a fortnight or three weeks, the flowers, which are edible, making a beautiful carpet on the ground. The flowers are followed as a rule by a large crop of pods, the cotton in which is valued for stuffing purposes, and when that is over, say by the middle of April, the tree resumes its coat of bright green foliage again.

GLIRICIDIA MACULATA.

Early in February a small tree which attracts much attention and admiration is *Gliricidia maculata*, known in the West Indies (whence it has been introduced) as "Madera." It is a very quick-growing leguminous species, with small pinnate leaves, and produces long arching feathery branches; the latter bear along the greater part of their length masses of lilac and purple flowers, making the tree a striking object. Its rapid growth and light foliage commend it for planting at suitable intervals among crops which require a quick-growing shade, and the same qualities together with its handsome blossom also render it a very desirable tree for forming foliage screens or for breaking the glare in low country gardens. For lopping as a green-manure, it appears almost as suitable as dadap. Mr. Drieberg, who was the first to introduce it into Ceylon, informs me that it is becoming popular with villagers for planting around their houses and along paddy fields, the leaves being used as a dressing for the latter. The tree has been planted on some low-country estates as a shade for cocoa, and has been successfully used as live supports for vanilla vines.

Photos by H. F. Macmillan.

SARACA DECLINATA.
Flowers bright orange-yellow.

TABEBUIA SPECTABILIS.
Flowers bright canary-yellow.

TABEBUIA SPECTABILIS,

a small tree of Tropical America, forms a magnificent object when in full flower, usually in March. It becomes almost quite deciduous just before every branch and tip burst forth in a profusion of bright golden small bell-shaped flowers, which are produced in clusters and radiate from a common centre in one plane. The flowers as they drop literally cover the ground. Unlike the two former species, however, the flowering is soon over, only lasting a few days, when the tree with equal suddenness puts on fresh foliage.

AMHERSTIA NOBILIS, THE QUEEN OF FLOWERING TREES.

Though this remarkable tree may be seen in flower to some extent almost all the year round, it is at the height of its glory only during the months of February to May. Its immense candelabrum-like sprays of red and yellow flowers, drooping from every branch and interspersed with the handsome pendulous foliage, present an appearance of astonishing elegance. It is unfortunate that the tree cannot be induced to set seed more freely, for practically everybody in the tropics with a garden would like to have an Amherstia tree. Those who are fortunate enough to have a tree can at any time "turn an honest penny" by propagating plants by layering, and selling them at a fancy price.

BROWNEA GRANDICEPS,

with its large round heads of bright red flowers suggesting large rhododendrons at a distance, is a very beautiful tree when in flower. Introduced from Brazil in 1870, it has now become fairly well known. It is in blossom at various seasons of the year, but is seen at its best in March or April, after the first rains. The foliage too is very handsome, the young leaves being produced in long, drooping flaccid bunches, similar to those of Amherstia.

SARACA DECLINATA

is a small leguminous tree of Sumatra which at this season forms a very striking object, producing huge clusters of blossom at the nodes of the branches and even along the stem. All parts of the inflorescence, including the stalks, are a bright orange-yellow, affording a striking contrast with the green foliage. The flowers are sometimes followed by large dark-crimson flat pods. Although the tree has been grown at Peradeniya since 1870, it is as yet very little known in the Island, notwithstanding that a good many plants have been distributed from the Gardens.

JACARANDA MIMOSAEFOLIA

is a very elegant tree, both on account of its handsome blue bell-shaped flowers and fine feathery foliage. During the months of February or March it is usually seen bearing a profusion of blossom on the young shoots as well as on the older branches. The small bi-pinnate mimosa-like leaves make young plants well worth growing as ornamental foliage plants.

BIGNONIA VENUSTA (VENUS'S BIGNONIA)

ranks among the most beautiful of creepers. The Tamils call it Tanga-poo (golden flower), though the name is hardly appropriate, the flowers being bright orange-red. It is a most gorgeous plant when in full blossom, usually in February or beginning of March, the drooping clusters of long tubular flowers having the effect of smothering the whole plant.

BIGNONIA UNGUIS

is a flowering creeper which baffles description, neither pen, camera nor brush being capable of doing it justice. It is a native of Brazil and, so far as I know, no popular name has yet been invented for it. An unobtrusive plant with thin, wiry, slender stems and small binate leaves (in pairs), it creeps by means of 3-hooked tendrils up to the tops of the highest trees, covering every branch, and is hardly noticeable until all of a sudden it flashes out in bloom at the end of March or beginning of April, according as

the rains are early or late. Along the length of innumerable long slender drooping stems and twigs the flowers are produced in clusters at every node. The aggregate effect is very remarkable, for the plant which appeared so inconspicuous before now suddenly supersedes all round it, smothering the tree on which it grows and making it appear as if it was there only to support and exhibit the creeper. In poetical language it suggests, in some cases, a waterfall of gold pouring down from space in rivulets and cascades; in other cases, as when on a conifer tree, it almost looks like avalanches of yellow snow, so completely does it cover the tree The more spreading and straggling a tree, therefore, the more graceful and picturesque the effect. The flowers are bell-shaped, bright canary-yellow, and slightly scented. They are followed in the course of a few months by curious flat, long. sword-like brown pods, from 2½ to 4 feet in length and about an inch in width. Inside these are closely packed flat winged seeds which, when ripe, are readily wafted about by the wind.

CANNON-BALL TREE (COUROUPITA GUIANENSIS).

This is a very remarkable large erect tree, which bears flowers in great profusion on long woody racemes all along the stem from the base to the top. The individual flowers are of very peculiar construction, being of a fleshy nature, pinkish white in colour, and emit a rather overpowering odour. The staminate portion develops a succulent growth which forms a hood arching over the centre of the flower. The large globular brown fruit, which is not edible, measures from 6 to 8 inches in diameter and takes about 9 or 10 months to ripen. The tree is a native of tropical South America and was introduced at Peradeniya in 1881. It grew and flourished here for some 18 years before flowering or fruiting. A Cannon-ball tree was planted in Peradeniya Gardens by KING GEORGE and QUEEN MARY on their visit to Ceylon in 1901.

FLAMBOYANTE (POINCIANA REGIA).

Last but not least of fine flowering trees, mention must be made of the Flamboyante, which is too well-known in the tropics to need a description. Those who have seen this gorgeous tree in blossom for the first time are not likely ever to forget it. It can be seen at its best in the low-country, as around Colombo, during the months of April and May, and visitors to the Island at that season invariably carry away with them an indelible impression of the Flamboyante. The latter is, of course, the French name for the tree, though it is also the one most commonly used. In India it is known by the name Golden Mohur, and sometimes Royal Peacock Flower and Flame-tree. The last name is by no means inappropriate. The tree is a native of Madagascar.

Amongst other plants which make now their principal flowering season may be mentioned the beautiful climber *Congea tomentosa*, with its enormous trusses of delicate pink inflorescence, the bracts of which are the showy part. Amaryllis in great variety make a very fine display, the dainty Rose-amaryllis being especially admired. Coming up from the grass a mass of pink, it is suggestive of the crocus season in England.

H. F. MACMILLAN.

AGRICULTURAL IMPLEMENTS.

TRIALS IN BURMA.

(i). *The New Cyprus Plough.*—This gave excellent results on this soil and it has been decided to use this type only on the farm and to recommend its use to cultivators. A few have already been sold and are giving satisfaction.

Photos by H. F. Macmillan.

CONGEA TOMENTOSA.

A beautiful climber. Flowers bright pink and faintly velvety. The persistent bracts constitute the showy part of the inflorescence.

BIGNONIA UNGUIS-CATI.

Flowers bright yellow, slightly scented. The curious sword like pods are seen to the left.

Its advantages consist mainly in the deep tilth which can be got by it, in its comparatively easy draught, and in the strength of its construction. With new points supplied now and again this plough should last for from 10 to 20 years. Its cost is Rs. 26 and it is made by MESSRS. RANSOME, SIMS and JEFFRIES.

(ii). *The Chindwin Plough.*—This is a similar type to the Cyprus, but only the iron parts are supplied, the buyer having to provide the pole and handle himself. It does fair work but lacks the rigidity and strength of the Cyprus and will not last nearly so long. It has an advantage in that its cost is only Rs. 12. It is supplied by MESSRS. CHAS. R. COWIE & CO., Rangoon.

(iii). *The Meston Plough.*—This does not give satisfactory results. The soil is not properly turned and all that happens is that a triangular channel is left behind the plough. Owing to the arrangement of the pole, also, there is no proper clearance in weedy land. Further tests will be made on clear land on the seed farm in Myingyan.

(iv). *Ransome's Turnwrest Plough.*—Two sizes of this were tried but did not give satisfaction as the drivers had trouble in using the two handles with which these ploughs are furnished and guiding their bullocks at the same time.

(v). *The Bullock Hoe.*—This is an implement for inter-cultivation in the case of crops grown in rows. At Tatkon where weeds and grass give much trouble, it has proved invaluable. For this work the ordinary Burmese *tun-do-gale* proved a failure owing to its being unable to effect clearance of the grass which piled up in front of it and made progress impossible. On light clean soils such as those of Meiktila, Myingyan and Pôakkku where ground-nuts are grown, the Burmese harrow used in row cultivation will give quite good results, but where weeds are bad the iron bullock hoe is the implement to use and recommend. It is supplied by MESSRS. BURN & CO. and costs Rs. 21.

(vi). *Winnower by Messrs. Burn & Co.*—This implement is badly constructed and will not be recommended.

(vii). The D. C. hand cotton gin received from MESSRS. BURN & CO. has given complete satisfaction and is extremely useful for selection work. It will also be recommended to cotton growers who desire a small hand gin for home use. Its cost is Rs. 170.

(viii). *Small Hand Maize Sheller.*—This was received from MESSRS. COWIE & CO. and costs only Rs. 5. It is meant to be fastened on to the side of a box into which the seed falls. It husks maize well, and doing more work than can be done by hand and owing to its small size and portability may be recommended to those desiring a small cheap machine. There is, however, need for a machine of large size to husk greater quantities and MESSRS. BURN & CO. were asked to procure one of the Lion type. So far, however, they have been unable to supply and this type will have to be tested later.

(ix). The Gardiner Oil Engine, Macartney cotton gin and baling press supplied by MESSRS. BURN are satisfactory.—REPT. OF THE HMAWBI AGRIC. STN., BURMA.

VITALITY OF SEEDS.

Speaking generally the life of a plant has two distinct phases, the one a period of activity and the other a period of rest, these alternating a number of times according to the "nature" of the individual, finally ending in the condition which we describe as death. The period of activity is, in the case of an ordinary green plant, the period when the green leaves and roots

are functioning to their utmost, working in preparation for the execution of the inimitable trick of "resting" which we find achieved in the confined space of its seed. This trick of seed-formation is quite unique, for by its means the plant has solved the question of carrying on in the confines of the smallest space, under self-made preserving conditions, the possibility of reproducing individuals like itself. The philosophy concerning the Primrose might well apply to a single one of its seeds, for here, if in any part of nature, we meet with a fundamental problem of life itself.

Seeds have been described as amenable things. For most part they produce that which is in them to order, with little difficulty to the husbandman. Given proper conditions of temperature and moisture the living seed will awake from its rest with high average certainty. Yet the facts of experience shew us that certain classes of seeds have, like all individuals, idiosyncrasies which dictate methods of manipulation if they would individually be made to reveal their secrets. What these idiosyncrasies are we need not dilate upon except perhaps to indicate that from the economic point of view there are two of importance, included under the items "dormancy" and "longevity."

Now it is natural that the seed presenting one of the enigmas of life with such an approach to uniformity, should have stimulated inquiry into its "*modus operandi*." How is the potential living tree provided for in the seed? Is the seed actually living and only sleeping in that life processes are constantly going on in a reduced amount, or, are all life processes suspended awaiting some extra stimulation to set them a-going. In other words "Is the state of rest real and absolute or only apparent. May the seed be compared to a clock wound up and only requiring the push of a pendulum to set it a-going, or is quiescence in the dry seed not really due to abolition of vital processes, but only to a diminution of these to such an extent, that they cannot be recognized?

Towards elucidating this matter many and various are the attempts which have been made. Resting seeds have been given such sorts and conditions of treatment that would knock life—such as we know it to be conditioned—out of anything. Poisons, intense cold and desiccation are among the "barbarities" which have been employed. Thus :—

Romanes kept seeds in ether and ammonia and absolute corrosive for months and still they came up smiling. From this he concluded that all life in the seed was suspended only to find himself questioned by Bequerel, who, experimenting on Peas, Lupins and Clover showed that in these cases at any rate the seed coat was an armour, preventing, in its dry condition, the entrance of the poisons.

Adams, working on peas, flax and barley, etc., with liquid air, concluded that there was no minimum temperature for dry protoplasm, abnormally low temperature only having effect when disintegration changes were set up through water and gas being present in the seed.

Thus directed, have we any knowledge that the actual processes of life are being gone through in the resting seed? Does the dry seed respire? As to whether this is so seems an undecided matter but as far as we are concerned here, the answer is possibly given by the result of the work of Kolewitz, who claims to have shown that respiration is not essential for the continuance of vital capacity. It is to be noted, however, that his conclusions have been much questioned—nevertheless evidence, such as we have, seems to point to the fact that unlike the hibernating animal whose vitality is slowed down during the periods of the animal's inactivity—the "resting seed" is in a condition of what is described as "static equilibrium" that is, that the functions ordinarily associated with life are actually suspended and await the stimulus—we know not of what—to show themselves.

The natural corollary to this seems to be that the dry seed is endowed with possibilities of the "life eternal." The experiments started by BEQUEREL will be of value towards elucidating this. At present we are aware of the existence of seeds of extreme longevity. The mummy-wheats are more than possibly "fairy tales," nevertheless we know of the existence of seeds which retain their vitality for very long periods. These for the most part are hard coated seeds whose very protection seems to be their water and gas-tight seed-coats.

The variations in the periods of dormancy and longevity are facts of common experience. Conditions of ripeness at time of harvest, subsequent complete drying and storing in dry atmosphere are perhaps the more important of the factors on which these attributes depend. As concerns the conditions of harvest we know that some plants produce one batch of seeds—their first harvest—which germinate at once and then a second crop requiring a longer period of rest. Among these comes the familiar golden chain, *(Cytisus laburnum)*.

PERCIVAL states that it is inadvisable to use seed of wheat, maize, cabbage and most grasses after periods of storage of 2 to 3 years. After this period death ensues.

But we meet with a type of seed diverging widely from these.

Some conifers do not even germinate for several years: some of the seeds of our English trees require frost before they will commence their activity and so on. The most instructive of the experiments done heretofore in the direction of elucidating the question of real longevity are those of BEQUEREL, who describes the results of seeds of 30 families and 350 species in all, stored for 25-135 years. The results show that of seeds of 25 years storing not one of those belonging to the orders Graminaceæ, Liliaceæ, Urticaceæ and Polygonaceæ germinated, but the record was obtained by three species of leguminous plants whose seeds after 80 years storing germinated. These, be it noted, had hard impermeable seed coats.

Now this question has economic significance of some magnitude.

ROSE, in a paper attempting the solution of practical problems of the seedman and grower, described hot water, various chemicals, such as sulphuric acid and various mechanical appliances—notably the machines of NILSLSON, where seeds are thrown against the concave surface of a rough stone or against a bank of needles—as devices of man to produce a greater germinating power and a greater germination-speed of these self-protected seeds.

The work of SHULL on this question of longevity is described in the GARDENERS' CHRONICLE for 27th September this year (1915). A pond undrained for 70 years was drained, and in a few months a most luxuriant vegetation of 140 species of flowering plants was found.

This prompted an inquiry into the provenance of this flora and experiments were started in 1905, in which year 6 jars with seeds submerged in earth and supernatent water were put away, water being added to make up evaporation as required. After 18½ months it was found that the following germinations took place: *Cyperus* spp; *Juncus tenuis*, *Meuhlenbergia diffusa* and others: in 2½ years *Lappa minor* formed in addition to the then germinating seeds, and after 7 years germination took place with *Sium aculifolium* and 2 species of *Juncus*.

Now it will be seen in comparing this latter with what has been mentioned previously that we have two distinct problems. The one, the dormancy and retention of vitality of dry seeds and the other that of moist seeds. As concerns this latter our knowledge has received a tremendous step forward from the work of KIDD on "The Controlling Influences of Carbon Dioxide in the Maturation, Dormancy and Germination of Moist Seeds."

KIDD shews that carbon dioxide in the tissues of the seed may be held

responsible for delayed germination. Further that the carbon dioxide acts as a narcotic in that its effect is transient and does not result in injury.

His inquiries and results are of very great importance and interest. Working with *Hordeum vulgare*, *Pisum sativum*, *Vicia faba*, *Brassica oleraeca* and *Allium crepa*, he shewed that all these under proper conditions as concerns water and temperature, would not germinate in atmospheres containing certain percentages of carbon dioxide, but that they came from their stupor unscathed when given back their proper conditions.

Continuing his enquiries he found that *Brassica alba* presented a still more peculiar phenomenon, in that the subsequent revival did not take place as expected—the seeds appearing to sulk after their treatment and only germinating after coaxing by special devices. This latter effect—the prolongation of narcosis—he proved to be due to the seed coat retaining the additional carbon dioxide and preventing its escape for, by removing the testa, he was able to eradicate the delay and bring the germination time to normal. Similarly by drying the seeds for 3 weeks or by immersing them in choloroform water for 70 minutes, he was able to produce the same effect. In his experiments, Kidd imitated what actually must occur in nature in cases of delayed germination, and in passing it may be noted that he solved the problem confronting Shull. In inquiring into the sequence of events which go on in nature he placed a number of bags of seeds of *Brassica alba* at various depths in the soil of a pit wherein he caused by natural processes —through the agency of decaying grass placed at the bottom of the same, the production of a carbon-dioxide atmosphere. The result of his investigation in the field showed complete accordance with those obtained in his laboratory.

Now this matter is of the greatest importance agriculturally, especially as concerns the question of green manuring. Results of work in India shewed that tobacco seed completely failed in germination if sowed soon after the crop of green manure (Crotalaria) was ploughed in. Also Java indigo planted 30 days after the ploughing in of Crotalaria gave similar failure. Kidd's further work suggests the complete explanation of these failures, for he shows that decreasing the free oxygen content of the "germination atmosphere" causes an increase in the inhibitory power of the carbon dioxide. Thus the reviewer of this work writes :—

"From the point of view of Indian Agriculture, Mr. Kidd's investigation suggests a line of work in connection with green-manuring which is almost bound to yield useful results. Experiments on this subject at Pusa show conclusively that green-manuring for cold-season crops only gives positive results on light, well-drained soils when the interval between ploughing-in the green manure and planting the next crop is about eight weeks. On heavy lands or on lands which are waterlogged from any cause, green-manuring leads to a smaller crop than that on control plots. Shortening the time between ploughing-in the green manure and planting the next crop gives reduced yields similar to those on heavy or waterlogged land. That these results are, in all probability, connected with the supply of oxygen in the soil is suggested by the effects obtained last year at Pusa in sub-soiling after green-manuring."

The actual physiological effect of the carbon dioxide is described as one of the true narcosis. It has been shewn that 7 per cent. of carbon dioxide depresses the growth of roots. Further that the general behaviour of these agents in small quantities is to stimulate. This is proved by Kidd's experiments on *Hordeum* and *Brassica* germinated in the dark.

It is perhaps worthy of note that Röntgen Rays behave in a somewhat similar way on dry seeds, accelerating their germination after slight exposure, retarding growth if the exposure is too long or intense, and here too the effect may remain latent for some time.

From MR. KIDD's work several points in Tropical Agriculture suggest themselves. The question of green manuring has been already touched upon; but further it may perhaps now be assumed that the common unfortunate experience of the padi planter, to whom the late cutting of the weeds spells failure and pecuniary loss, is due to the excess of carbon dioxide produced in his "unripe manure." Also the particularly interesting puzzle of rubber seeds whose viability has proved to be of such short duration seems now to be solved. It is shown that this seed has a highly permeable seed coat, that it is intolerant of drying and that it has a high water-content. 40—50 of these seeds in 1,200 c.c. of air were found to set up an atmosphere containing 40—45 per cent. of carbon dioxide and this atmosphere was found to effect a prolongation of life.

From KIDD's results we may perhaps assume that the rapid falling off of the germination of rubber seed is a fact which may be eliminated to order:

"The favourable results obtained in these experiments in prolonging the vitality of these rapidly deteriorating seeds were greatly in excess of those which are secured by present commercial methods of packing for transport and import. In experiments on a large scale the seeds might be simply sealed (in the proportion of air mentioned) in large carboys, such as are used for the transport of distilled water, covered with wicker or wire netting. In case of too high an internal pressure, arising from overfilling with seeds, a simple form of safety valve might be inserted in the sealing."

In commenting on the significance of this addition to our knowledge we find some instructive reading in the pages of the GARDENERS' CHRONICLE, where the possible importance of this to the seedsman and collector are emphasized. Further the method is so full of suggestions that it appears possible that the horticulturist may become an even more subtle conjurer, changing for example the periodicity of first, second and third earlies, etc.: in such crops as peas. But to return to the original question, we still await the result of science to expound to us the riddle of the dry resting seed.—

G. E. C. IN F. M. S. BULLETIN.

AGRICULTURAL EXPERIMENTS AT ST. VINCENT.

From the Report on the Agricultural Department, St. Vincent, 1914-15, issued by the Imperial Commissioner of Agriculture for the West Indies, we take the following extracts which may prove of interest to readers of this Journal.

ARROWROOT.

The small series of arrowroot manurial experiments at the Experiment Station was continued, but without any definite results, and, like the cotton manurial experiments, this may have to be carried on for some years on the same land before results of any value are obtained.

MANURIAL EXPERIMENTS WITH ARROWROOT.

No. of Experiment.	Sulphate and Potash.	Basic Phosphate.	Yield of Rhizomes per acre in lb.		Mean.	Difference on no Manure.
			Series 1.	Series 2.		
1	No manure		20,472	20,411	20,442	...
2	1 cwt.	...	19,056	17,927	18,492	—1,950
3	2 ,,	4 cwt.	22,309	21,815	22,062	+1,620

It should be added here that the manurial experiments laid out in 1/10 acre plots, in duplicate, at Spring Estate in the endeavour to ascertain the effect of applications of cotton seed meal, basic slag and sulphate of potash on arrowroot, were so badly cut up and damaged by storm-water in November that they had to be abandoned.

CASSAVA.

The plot experiments with the object of ascertaining whether the yield of cassava root is influenced by the method of planting were continued. A slightly increased yield of green roots was obtained from the cassava cuttings planted on the "flat" as against plantings made on ridges or banks. The results obtained are as follows :—

—	Flat forked. Calculated yield per acre in lb.	Banked. Calculated yield per acre in lb.	Increase on Banked Cultivation.
1913–14	17,570	14,054	3,516
1914–15	10,070	9,577	493

BERMUDA ONIONS.

Some years ago an attempt was made to cultivate the white and red Bermuda onion, but insects, more particularly the "mole cricket" *(Gryllotalpa didactyla)*, proved very destructive to the seedlings. Another trial was made at the end of 1914 from seed obtained through the Imperial Commissioner of Agriculture from Teneriffe.

The Assistant Agricultural Superintendent sowed the first lot of seed in drills on the flat, but on the Agricultural Superintendent's return from leave he adopted the system with which he had had considerable experience in Antigua. The results obtained, although the sowings were made rather late in the season, were instructive, and the opinion is now expressed that with reasonable care and attention Bermuda onions can be successfully cultivated in the Colony. The soil is an ideal one if well prepared, and the climate usually suitable. In the dry season the mole cricket burrows deeper down in the soil than in the wet season; therefore if the onions are grown on banks or ridges they are not so likely to be damaged by this pest.

The following are the details of the experiment :—

	Plot.	Date sown.	Calculated yield per acre in lb.
1	Seed sown in drills 1 foot apart on flat forked land. Seedlings thinned out.	Oct. 29	2,966
2	Seed sown in beds. Seedlings transplanted on banks. Banks 3 feet apart, 3 rows on each bank.	Nov. 10	7,200
3	Seed sown in drills on banks, 3 drills on a bank, and seedlings thinned out.	,, 27	2,365

The bulbs were ready for reaping at the end of February and the

beginning of March. Those in the second plot were sound and regular in size, and had an average diameter of $2\frac{1}{2}$ inches. The seedlings and bulbs in the first plot were much troubled by mole crickets. Although the onions reaped were in every way equal to those obtained from the second plot, a much larger percentage of them rotted. The second plot was sown too late in the season, and the plants did not have a long enough growing season, with the result that the bulbs, although sound and even, averaged only $1\frac{1}{2}$ inches in diameter.

The produce of the plots was readily sold locally at good prices.

Further experiments on a far larger scale will be undertaken at the Experiment Station and on estates next season.

FUNGI ON TEA IN NORTH-EAST INDIA.

A. C. TURNSTALL.

Continuing previous reports (E.S.R., 32, p. 346), the author states that *Nectria cancri*, associated with canker of tea bushes, probably attacks its host originally through cavities resulting from improper pruning or injuries by hail, cattle, etc. Spores grown in the laboratory have not given successful inoculations up to the present time. As the fungus travels readily downward it is necessary to cut away all dead twigs and some depth of living wood for a distance below the dead portion, applying Bordeaux mixture freely.

Copper blight *(Laestadia theæ)* is contrasted systematically with grey blight *(Pestalozzia palmarum)* and with brown blight *(Colletotrichum camelliæ)*. Copper blight is more noticeable during drought succeeding heavy rains, and so is often attributed to hot sunshine, which may hasten development of the fungus and browning of the leaves. Removal of all affected leaves and application of Bordeaux mixture should immediately follow the appearance of this disease, and a second spraying should follow two weeks later. For cases of general infection a treatment to be used during the cold weather is outlined which is claimed to remove copper blight, also minor blights, and to stimulate production by the tea bushes.—Experiment Station Record.

AGRICULTURE IN BENGAL.

The Provincial Agricultural Department's report for the past year is an interesting record of sincere and useful work done to improve what is and must for long remain the chief industry of the province. The Government of India and the Provincial Governments are often reproached for their alleged lethargy in regard to the industries of the people. A great industrialist has just declared that, so far as mechanical industry is concerned, all his experience goes to show that when the Indian capitalist is in earnest the co-operation of Government is freely given. Those who will take the trouble to study the Agricultural Journal and such annual reports as those the Bengal Agricultural Department now publish will realize that at Pusa and on the Government farms, scattered all over India, Government are showing themselves no less willing, and no less laborious in their efforts, in regard to agriculture. Bengal has its seven demonstration farms and its dairy farm recently visited by the Governor at Rangpur. It has its Agricultural Chemist, its Economic Botanist, its Fibre Expert, its Sericultural Expert. In the Provincial Service it has its Superintendent of Agriculture for each division and in the Subordinate Service its District Agricultural Officer in many of the

districts. These subordinate services are at present merely tentative, but there seems every reason to believe that when the extraordinary situation created by the war has given way to the normal condition of things they will expand until research and demonstration, carried on in close touch with the ryots themselves, in part through field demonstrators, will be conducted in every district of the province. The extent of the ground already covered is seen even from a cursory perusal of the Government resolution. The Fibre Expert has devoted himself to the important questions of jute seed selection and jute manures. He is now engaged in inducing the peasant cultivator to avail himself of the result of his investigations. The Agricultural Chemist has meanwhile been at work completing his collection at Dacca of all the varieties of sugarcane cultivated in the province. The idea is, by the crossing of varieties and by experimenting in soils and manures, to improve the output. Some attention has also been paid to the output of palm sugar, and District Officers and persons interested in the sugar industry have been advised as to the opportunity for an advance which has occurred as a result of the war. The Economic Botanist has been at work attempting the elimination of a troublesome disease which attacks the rice plant. The Sericulturist, also fully awake to the opportunities created by the war, seems to have pushed on with his scheme, described in the Resolution as designed "for the saving of the silk industry in Bengal." The original idea was to set up enough Government nurseries to supply all the seed cocoons necessary for the province. It has now been ascertained that twenty-two central nurseries—of which eight are already in existence—would be required to achieve this purpose. In view of the heavy cost of the scheme it has therefore been decided to rear only one-third of the requisite number in Government nurseries, the rest being raised by selected professional rearers, under Departmental supervision. Here, in regard to four of the province's agricultural staples—jute, rice, sugar, and silk—sound work, it would seem, is being done. This is by no means a record of the Department's achievement. It is merely a selection intended to show that, in large part unknown to the more clamant political cases, aid is being given and intelligence is being brought to bear alike on the normal and recurring difficulties of the cultivator and on the opportunity for "making good" which has come to him as the result of the war in Europe. The Department has itself several classes of obstacle to strive against. It has had to cope with the depressing, although necessary, tendency to scrutinize expenditure in these difficult times. At least four of its schemes have been subjected to postponement or the paring process which must be galling to the enthusiast. It has, too, to cope with the ryot's conservatism, which often strives against even the demonstrated good. The zemindars have not shown themselves over eager to take advantage of the scheme for the practical training of their sons at Dacca. These, however, are obstacles which the Department expects to meet and ought to overcome. To show by experiment and demonstration that scientific agriculture pays better than rule-of-thumb agriculture is its mission and it need not be down-hearted because it does not achieve in a year what, in Bengal, it will probably take decades to accomplish.—THE INDIAN AGRICULTURIST.

EXPERIMENT STATION, MAHAILLUPPALAMA.

(Progress Report from 15th December, 1915, to 15th February, 1916.)

The 9th picking was done in January, 1916. The number of nuts collected was 1,371 from 337 trees, an average of 4·06 nuts per bearing tree or ·81 per acre tree.

This gives a total of 24,269 for the year 1915 from an area of 23½ acres composed of Plot A 17 acres of 7 year old trees and Plot B 6½ acres of 8 year old trees (number of trees per acre 70).

In the irrigable area (7 year old trees) consisting of 1,224 trees, 303 trees gave 980 nuts, an average of 3·26 nuts per bearing tree.

The unirrigable area (8 year old trees) consisting of 449 trees, 4 trees gave 198 nuts, an average of 5·8 nuts per bearing tree.

The following figures have been obtained with regard to copra production:—

COMBINED PLOTS.

Picking.	*Break nuts.*	*Rejections.*	*Copra lb.*	*No. of nuts per candy.*
November ...	3,793 ...	½% ...	1,750 ...	1,204
		Plot A.		
November ...	3,421 ...	½% ...	1,600 ...	1,191
		Plot B.		
November ...	372 ...	— ...	150 ...	1,388

A consignment of copra was sent to Colombo and sold on 1st February, 1916, fetching Rs. 81 per candy.

2. Plot A has been flooded in order to plough and disc-harrow. All young palms have been well forked round and mulched with either coconut husks or cheddy after an application of cattle manure and ashes.

Irrigation channels have been cut down all rows to keep the palms watered through the dry weather.

3. On the unirrigable plots the young palms are watered once a week by means of a hole at the side filled in when the water has subsided.

FRUITS.

The mango trees and citrus are also being kept irrigated. The latter are bearing good crops of fruit.

DUDLEY S. CORLETT,
Acting Manager,
Experiment Station, Mahailluppalama.

TRAVANCORE DEPARTMENT OF AGRICULTURE AND FISHERIES.

The following is a summary of the main results of work done by the Department of Agriculture and Fisheries, Travancore, for the year 1914-15.

(i) A general awakening and a spirit of enquiry about agricultural matters have been aroused among the people, and they are becoming increasingly conscious of the necessity of improving their cultural methods.

(ii) A new impetus has been given to the development of the coconut industry. Greater care and attention are now being bestowed upon the cultivation and manuring of this, the most important, crop of the country.

(iii) Single seedling transplantation of paddy has been introduced into several parts of the country, and is spreading rapidly in Nanjanad.

(iv) Some new varieties of paddy (chiefly Banku and Ambamore varieties) have been introduced into the country and are becoming popular.

(v) The question of manuring the paddy crop is receiving greater attention from the ryots, especially of Nanjanad.

(vi) The cultivation of groundnut and Guinea-grass newly introduced into the country is spreading.

(vii) Considerable success has been attained in conserving, within the country, oil-cakes and prawnskin for manurial purposes.

(viii) The opposition of the ryots to the use of light iron ploughs is being gradually overcome and a large number of them are being sold every year.

(ix) An increasing number of cows are being crossed by Government breeding bulls year after year. The offspring of such crosses are admittedly of a better type than the ordinary run of cattle of the country.

(x) Infectious diseases and insect pests of crops are being kept under control by the adoption of proper preventive and remedial measures.

(xi) The feasibility of introducing silk-worm culture into the country has been demonstrated, and arrangements have been made for opening a sericultural school with a view to train boys in this new industry.

(xii) Proper veterinary aid is being rendered to the ryots in treating their live-stock for ordinary diseases, and in dealing with outbreaks of contagious diseases.

(xiii) Though nothing worth mentioning has yet been done in agricultural education, ideas about agricultural improvements are being disseminated among the ryots by answering enquiries, distributing leaflets, delivering lectures, and by the publication of a vernacular Quarterly Agricultural Journal.

PRODUCTION OF CITRONELLA IN CEYLON.

The market for this article fluctuated considerably between 68 to 70 cents and 83 to 85 cents per lb.

The total exports for the year was 1,696,684 lb. of the value of Rs. 1,499,034.

	1915.	1914.	1913.
United Kingdom ...	458,888 lb.	... 615,509 lb.	... 637,138 lb.
America ...	902,744 ,,	... 530,609 ,,	... 548,961 ,,
France ...	87,231 ,,	... 25,046 ,,	... 57,250 ,,
Germany ...	— ,,	... 814,010 ,,	... 298,577 ,,
Australia ...	128,905 ,,	... 109,400 ,,	... 59,870 ,,
Other Countries ...	95,000 ,,	... 68,976 ,,	... 38,944 ,,

—L. C. P. A. REPT. FOR 1915.

PERADENIYA EXPERIMENT STATION.

(Progress Report from December 15, 1915, to February 15, 1916.)

TEA.

The yield for the month of December was 4,617 lb. green-leaf and for January 2,607 lb., from 10 acres of newly-pruned tea.

2. The November made tea fetched in Colombo 56 cents per lb. for Broken Orange Pekoe and an average of 48·50 cents for all grades.

3. Plots 146—150 were pruned in January, leaving a live branch to carry the bushes through the dry weather.

4. In plot 150 Albizzia trees were pruned yielding 1,791 lb. green mulch.

5. The supplies, which have been nursed with so much trouble to become established, are suffering from the drought.

RUBBER.

6. The trees are wintering much earlier this year owing to the drought and are now standing stripped of leaf.

7. In January the *Tephrosia candida* in all the young plantations was cut for the twelfth time and mulched to the trees after they had been lightly forked round.

8. The Acting Government Mycologist has instituted a series of experiments with a view to preventing further development of the bark-rot disease.

9. All other trees under tapping experiments have had the newly-tapped surfaces covered with a thin coating of a mixture made by boiling 1 oz. of sulphur in half a kerosene tin of water and adding equal parts of fresh cow-dung and clay till a thick paste is obtained. A pinch of salt added will tend to keep the paste moist and prevent cracking and peeling off the trees. The object is to protect the exposed, delicate, cambium layer from sun and drying winds, as a precaution against Bark-rot and to encourage good bark renewal. This should be applied monthly during dry weather to within a quarter of an inch of the tapping area.

10. The Rubber-creping machine having become worn-out is of no further use for creping the dry biscuits, and as funds are not available to purchase a new machine, the biscuits are being sold in Colombo. The biscuits fetched Rs. 2·31 per lb. and crepe Rs. 2·40, but it costs 20 cents per lb. to crepe the biscuits by an outside factory; so there is no object gained in creping.

COCOA.

11. Pickings have continued fortnightly and the autumn crop is nearly finished. There is very little sign of a spring crop of any quantity, owing to the exceptionally dry North-east Monsoon, no rain having fallen since January 21st. In consequence much of the newly-set fruit has fallen.

12. A round of canker and pruning has been finished—bark canker not being nearly so prevalent as last year.

All young plants have been forked round and the *Tephrosia candida* cut and mulched in Plot 60 for the seventh time.

COFFEE.

13. The old plants are showing the effect of the severe drought. The young plants under their dadap shade are withstanding the drought better.

COCONUTS.

14. The young palm plantation has been thoroughly weeded and disc-harrowed and all drains cleared and cleaned, the cheddy being mulched round all young supplies after forking round.

PADDY.

15. The Hondarawalu and Philippine varieties have been harvested and also the major portion of LOCK's selected-seed paddy was transplanted. Full yields will be published later.

16. The small plot of Hondarawalu which was the first to come into flower was badly attacked by paddy-bug (*Leptecoria varicorni*). A long sweep not worked by ropes was first tried, but owing to the irregularity of the field-banks its working was not a success.

Spraying with kerosene and carbolic was also tried, without success. Finally, ordinary insect-nets with long handles were employed and it was found that two men in half a day could net and destroy as many as 4,000 insects.

17. There was a marked difference in the growth of the transplanted and broad-cast portions of the field, the former possessing a tall, vigorous growth bearing large heads of fine seed and many stalks to a stool. During

January high winds were experienced and though the transplanted paddy was beaten down here and there by pockets of wind striking it, on the whole it stood very well, while the broadcast was badly beaten down.

18. Ten days before harvesting various green-manures, such as *Tephrosia purpurea* (Pila), *Crotalaria juncea* (sunn hemp), and several varieties of cow-peas and gram were sown broad-cast in the standing paddy in the water. This was drained off with the object of allowing the soaked seed to germinate and take root in the soft mud. The experiment, however, was not a success as the seeds did not germinate well.

19. Before harvesting all stools with 12—15 stalks bearing good ears were cut and set aside for seed for next sowing. As each head bears at least 50 seeds, 12 stalks will yield 600 seeds the product of a single plant grown from one seed.

20. The water having been drained off the fields were firm for harvesting. Some of the sheaves stood well over 5 feet and were formed into stooks of 6 to 8 sheaves on the fields to allow of drying and the seeds taking up the remainder of food-store left in the stalks.

21. Many hundreds of years ago the Egyptians, as producers of barley, wheat and rice on a large scale, invented a simple implement for threshing the crop quickly and efficiently. In a wooden frame were placed 3 or 4 rows of 6 revolving thin iron discs, over which was erected a seat for the driver of the two bulls or sometimes camels.

Applying this method to modern agricultural implements, the disc-harrow has been used to thresh out this crop and has proved a perfect success. Not only does it thresh out the grain quickly and thoroughly but only two bulls are required instead of at least six. Secondly the straw is so bruised by the discs as to render it better as a cattle-fodder, for which it is principally used in Ceylon.

42 bushels (520 large bundles of straw) were threshed by 7 men and 2 bulls in 10 hours. The winnowing was done by the wooden hand-winnowing machine, and the whole operation of threshing, winnowing and sacking the grain was completed by 18 men in 17 hours.

As soon as the harvest was over the fields were well ploughed and disc-harrowed ready for sowing green-manure in drills, to be irrigated.

22. A party of over 60 villagers and Headmen brought by Ratemahatmaya Nugawela were shown the standing crop and the methods of cultivation in working. Many other local visitors have also inspected these paddy fields and have expressed their opinion of the great value of such demonstrations and their desire that they should be extended to the big centres of paddy growing in the low country and under the larger tanks, where the improvement in cultivation and the proper understanding of water-control is urgently needed.

PLUMERIA PERFUME.

23. The Plumeria (Temple Tree) plants on which the Vanilla vines are growing are, in one year's growth, bearing a profusion of flowers. A visitor from England interested in essential and perfume oils asked if anything was done in Ceylon to collect this valuable perfume.

As Vanilla or Plumeria grown separately for their products are not very paying crops, grown in conjunction with each other the results might be more encouraging. So experiments have been started to extract the perfume both by distillation and by absorption by pure vaseline, from the flowers laid in trays. The advantage of Plumeria is that it bears a constant profusion of strongly-scented flowers, which take 3 to 4 days before they wither.

MANILA HEMP.

With forking round the plants and mulching with cheddy and leaves,

the drought has so far not affected these plants, which continue to show satisfactory growth.

ECONOMIC PLOTS.

25. The Giant Russian Sun-flower has suffered from the drought—but the finest plant was 6 feet high and the flower 11½ inches in diameter. Though full of seeds the husks appear to contain very few seeds of small oil content.

26. The cottons are also suffering from lack of water and are flowering before they have grown enough.

DUDLEY S. CORLETT,
Manager, Experiment Station, Peradeniya.

CULTIVATION OF ONIONS.

The onion is one of those profitable garden crops which have a ready market in this country and abroad, the onion bulb forming a necessary and everyday article of food of the masses. Moreover it is a crop which can be stored and kept for some time.

SOIL.

As the onion is an irrigated crop and has to develop its bulb mostly under ground, it requires a fairly deep soil having good drainage. It can, however, grow on almost any description of soil which is sufficiently deep. Very deep sticky clay soils are, however, unsuitable for this as well as for almost any irrigated crop, but in the Dharwar district deep retentive black soils are employed for a rain fed crop of onions.

SEASON OF GROWTH.

The onion will grow at any time throughout the year, but the cold weather crop thrives best. Very moist and warm weather, such as occurs in the rainy season in most parts of the Bombay Presidency, is not favourable for this crop, and excess of water at any time during the period of its growth is harmful. For this reason the rainy-season onion never yields as heavy a crop as the winter onions.

ROTATION.

This crop can be taken in rotation with any other irrigated crops such as potatoes, chillies, groundnut, irrigated wheat, gram, sweet potatoes, and the like, and is often taken after an early dry crop of some pulse such as *Mug* or *Udid* or groundnut, etc. Usually the onion is cultivated alone without any mixture; in Dharwar district, however, coriander is taken as a mixed crop in the *Kharif* crop of onion. But it may very well be taken as a subcrop in the earlier years of fruit plantations.

PREPARATION OF THE FIELD.

The land should be thoroughly ploughed to a depth of about nine inches and further pulverized fine by subsequent clodcrushing, harrowing, levelling, etc. Farmyard manures or poudrette should be given at the rate of eight to ten tons per acre before ploughing.

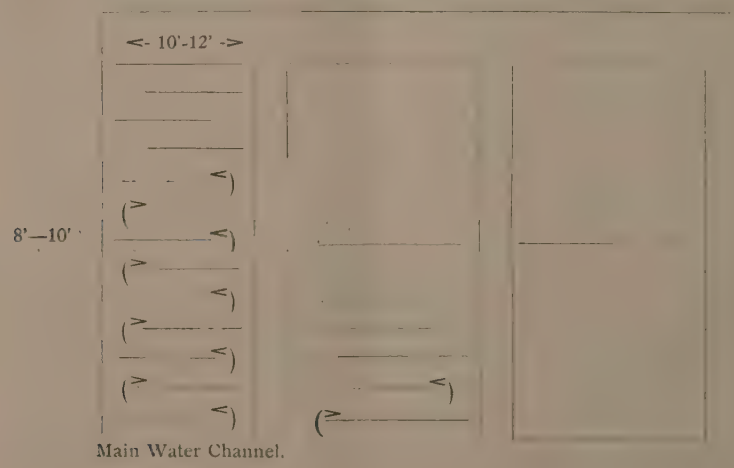
SEED AND SOWING.

The onion crop is best grown from transplanted seedlings. These seedlings are reared in a seed bed. About two gunthas of seed bed is sufficient to produce seedlings for transplanting one acre. The seed bed should be thoroughly prepared fine and firm by deep ploughing or hand-digging and subsequent working the land. Well rotted farmyard manure at the rate of twenty tons per acre of seed bed should be applied together with a dressing of ashes. Beds should then be made three feet wide and as long as the level of the land will admit, keeping a water channel between each series of beds as shown in the following diagram:—

Seed should be sown evenly in these beds, preferably in shallow furrows three to four inches apart across the beds as shown in the above diagram. A seed rate of ten to twelve pounds of good sound seed distributed over two *gunthas* will produce sufficient seedlings for one acre. After sowing, the seed should be lightly covered with a thin layer of earth. The first watering must be done very slowly, but very frequently; in fact for small areas it is best to irrigate the seed bed by hand twice a day. When the seeds have well germinated, watering may be done by flow irrigation by filling in the furrows between the beds, taking care never to rush the water over the seed bed. The seed bed must be kept free of weeds rigorously, and the space between two lines should be lightly raked and stirred. Thus nursed, very vigorous seedlings will be obtained ready for transplanting in about five to six weeks. By this time they are about six inches high. Seedlings taller than nine inches will not be very satisfactory. Thus the seed bed ought to be sown six to seven weeks before it is desired to plant the onion crop. In Dharwar district, the *Kharif* rain fed crop of onion is drilled both lengthwise and across with an ordinary four coultered drill having its coulters twelve inches apart, about the beginning of July. The rate is three to four pounds per acre.

TRANSPLANTING.

For this purpose the field has to be divided into flat beds or ridged beds. Experiments by the agricultural department have proved that the ridge system of planting gives a greater yield and profit than the bed system. For the ridge system ridges and furrows are made at a distance of fifteen inches by a country plough or any of the ridges and water channels opened by the same implement at a distance of ten to twelve feet across these ridges. All the ridges should then be divided into ridged beds to secure even distribution of water. A field prepared in this way would look as follows :—



The slope of the field is indicated by the direction of the arrow head.

The plot bed system of planting is preferred by some as it produces medium and uniformly round sized bulbs without splitting. Such a quality is more durable than the big bulbs obtained in ridge system, and which have a tendency to split and are hence prone to rot in storage. The former for this reason fetches a better price: but in the ridge system what is lost in quality is more than made up in quantity. Wherever the bed system is practised the field need not be ridged, but only made into flat beds of convenient sizes as in the ridged bed system.

After the field is thus ready the seedlings are to be transplanted. On the day previous to that fixed for transplanting, the seed bed should be irrigated to soften it so that the roots may not be broken while uprooting. The seedlings should preferably be uprooted on the day of transplanting, very gently and carefully and kept in baskets with wet mud sticking on the roots. The tops of the seedlings should be cut to reduce evaporation and transpiration and to prevent lodging. Water should first be let into the beds or ridges and when they are sufficiently soaked seedlings should be set on each side on the ridge at a distance of about four inches from one another, by thrusting the root end in the softened soil. Usually eight women are required to keep pace with one irrigator. A second irrigation should be given on the third or fourth day and the third after four or five days again. By this time the soil gets sufficiently moistened and the roots also revive from the disturbance and settle down in their new home. Subsequent waterings may therefore be given until the crop is ready, whenever required, which is usually at an interval of eight or ten days or even less according to the nature of the soil, the quantity of water given each time, and the season.

AFTER-CARE.

Besides irrigation the crop does not require much attention. It has been found by experiments on the Agricultural College Farm, Poona, that in addition to the quantity of farmyard manure mentioned above a dressing of sulphate of ammonia at the rate of 300 to 400 lb. per acre given before transplanting or a top dressing of nitrate of soda at the rate of 400 to 500 lb. per acre, when the crop is one month old, gives more outturn and profit. Nitrate of soda has been found superior to sulphate of ammonia. In the winter season, usually, the trouble from weeds is not serious especially when the land has received thorough cultivation as described above. Still one or two light weedings and stirring the soil and breaking up the crust may be required.

HARVESTING.

Four months after transplanting some plants begin to flower. These flowers should be removed. After about a month more the leaves begin to turn yellow and droop down. At this stage the onions should be considered as ready for harvesting. The rain crop in Dharwar becomes ready for harvesting in November and December. The process of harvesting consists in uprooting the plants with the bulbs by hand, which can be easily done as the onion bulbs are very near the surface and only very shallow rooted. After uprooting, the leaves and root stock of the bulb should be cut and the thin papery loose scales removed. This makes the bulbs ready for market. Injured and unsound bulbs should be sorted out, as these present a bad appearance and tend to cause rotting. Double or bifurcated bulbs easily rot and hence are not much liked by customers. So these should also be sorted out.

YIELD.

An average crop of winter irrigated onions on a medium black soil should yield 20,000 lb. of bulbs per acre, fetching on an average Rs. 150 or more according to the market. But the outturn may vary considerably as the crop can be grown on almost any description of soil. In a poor soil the outturn

may be only 10,000 lb. per acre, while under more favourable conditions it may go as high as 30,000 lb. or even more.

The total cost of cultivation amounts to about Rs. 125 when labour of man and bullock is charged at Re. 0-5 0 each per day, of a woman at Re. 0-2-6 per day and manure at the rate of Re. 1-8 per cartload (800 lb.). The *Kharif* dry crop of onion in Dharwar district yields at the rate of 5,000 lb. of bulbs per acre worth Rs. 100 at a cost of production of Rs. 20 per acre.

DISEASES.

This crop is almost free from any insect or fungus diseases. In some years, however, it is attacked by an insect disease called "Thrips." These are very tiny yellowish insects which crowd on the surface of leaves and suck up the sap. This pest thus weakens the plants and considerably reduces the outturn. It can, however, be efficiently controlled by spraying the crop with Rosin wash as soon as it makes its appearance. The method of preparing this is as follows :—

ROSIN COMPOUND.

Powder two pounds of rosin and one pound of washing soda (Sodium Carbonate) crystals. Place these in a kerosene tin or a large metal vessel, with enough water to cover them and boil. Continue boiling till both are dissolved and then slowly add cold water to the steadily boiling fluid. Water is to be added very little at a time, for fear of chilling the liquid, and the mass should gradually be brought up to two gallons. The liquid changes as the boiling proceeds, becoming thick and soapy; after boiling for half an hour or longer, the liquid becomes clear and thin, of a deep brown colour. Continue boiling, pouring a few drops of the mixture into the cold water at intervals; at first the wash on mixing with cold water forms a slightly milky opaque fluid but after some minutes' further boiling it forms a clear amber liquid on being mixed with cold water.

This is the test of the liquid being finished and it should on cooling remain clear. To this stock solution, six gallons of water may be added to make the strong wash, ten gallons to make the normal wash. One pound of rosin is used for every four to six gallons of wash required and half as much soda. The wash keeps indefinitely if properly prepared, and it is best to keep the stock solution and dilute it as required.

To prepare solution sufficient for one acre about 10 lb. of rosin and 5 lb. of washing soda costing Rs. 2 will be required, and usually two such sprayings at an interval of a fortnight are necessary.

STORAGE OF ONIONS.

As there is a rush of all the harvest at about the same time into the market the crop at such a time fetches a very low value and storage is therefore desirable to just watch for a chance of better prices. Onions can be best stored with the least loss in sufficiently large quantities, if they are kept in a dry, cool and thoroughly ventilated place. In onion growing tracts special storage houses are constructed out of grass thatchings, the sides being also made of bamboos with spaces between the bamboos to admit of thorough circulation of air. The bulbs must be sorted very often to remove any rotting or rotten bulbs: otherwise these become the nuclei for further rotting. The thinner the heaps can be made the less liable they will be to heat and to decomposition. They will, moreover, get thorough aeration, and can be inspected more easily. For this purpose if racks are made with shelves closer together it will economise space and keep the onions better and cheaper.

GROWING THE ONIONS FOR SEED.

Onion plants when grown from seed do not yield good seed when grown in one season only. The plants though flowering do not give seed which will yield bulbs after the next sowing. In order to obtain seed capable of developing

into good bulbs, the bulbs from a harvested crop should be given some months' rest and the whole bulbs, or the lower part of the bulb is planted in the month of October or November in a field well prepared and manured. Each bulb with rootside downward is planted at a distance of eighteen inches apart each way. The shoots give out branches of flowers which yield seed in about five months. Watering, weeding and other cultivation should be given as necessary. The outturn of seed from an average crop is 200 lb. per acre which sells at the rate of Re. 0-8-0 to Re. 1 per pound.

VARIETIES.

There are two chief varieties grown in this Presidency—white and red—white is milder in flavour, while the red is more pungent. Both require similar conditions of soil, climate and cultivation, but the red generally yields a larger bulb than the white one. The variety which is not commonly grown in a particular locality generally fetches a better price in the market of that locality.—BOMBAY AGR. DEPT. LEAFLET NO. 2 OF 1915.

KAPOK AND TREE COTTON.

We recently had an enquiry about tree-cotton from a local resident who wanted to be certain about the true significance of the term owing to the loose way in which it has come to be used.

At one time the term cotton was applied only to species of *Gossypium* and the name "tree cotton" or "silk cotton" to Kapok, *Ceiba pentandra (Eriodendron anfractuosum.)*

Of recent years both "tree cotton" and "silk cotton" have been applied to certain new forms of *Gossypium*. Some years ago we saw a species of *Gossypium* in Bangalore of decidedly arboreal form while some of the hybrids connected with the name of DR. THOMATIS produced a strikingly silky staple.

In view of the confusion existing, we should strongly advise that the term cotton be reserved for the produce of the genus *Gossypium* and not applied to *Ceiba* which should always be called kapok.

Those who are unfamiliar with the Sinhalese language are inclined to call Kapok "kapu" owing to the similarity of the two words. Kapu in Sinhalese means the product of *Gossypium* i.e. to spinning cotton as distinct from kapok (a word of Malayan origin) the produce of *Ceiba*, the native name of which is "imbul" or "pulung," the tree itself being known as "imbul."

There is just now a good demand for kapok not only for the manufacture of life-preserving apparatus but also for making explosives (in which it is taking the place of cotton) in Japan. We have also heard that the difficulty of mixing it with silk has been overcome.

Enquiries have been received about a dwarf kapok which comes into bearing in the second year. We have not been able to trace a variety that answers this description. The tendency to dwarf growth in South India and in the drier districts of Ceylon is not seen in the moister parts of the Island: but it is possible to keep trees from growing up naturally to their full height by judicious handling during their early growth, and this is specially desirable in the case of the kapok since it would considerably reduce the cost of harvesting the crop.

C. D.

WOOD PULP.

Wood pulp, which, as is known, is the principal substance in the manufacture of paper, comes to England in two forms—chemical and mechanical.

Both may be wet or dry. As the terms indicate, the pulp in the one case is produced by mechanical means and in the other by chemical, the latter being the superior product.

The chemical pulp comes to this country as bleached and unbleached. In the 10 months ended October 31, 1915, out of a total import of dry pulp of 327,528 tons, valued at £3,044,587, 8,961 tons (bleached) and 234,522 tons (unbleached), of a total value of £2,207,362, came from Sweden.

The import of chemical wet pulp is insignificant compared with that of dry pulp, being from all sources only 9,611 tons, valued at £32,026 in the period above mentioned.

The import from all sources during the 10 months ended October 31, 1915, of mechanical wet pulp was 454,591 tons, of the value of £1,237,679, of which Norway supplied 298,698 tons, of the value of £793,079. Sweden supplied 111,531 tons, valued at £317,046. The import of mechanical dry pulp is relatively small.

Thus, of an import, valued at £4,302,266 the Swedish share is £2,524,408, or more than half.

The other principal sources of chemical wood pulp are Russia, Norway, and Germany. Of course, since the war the quantity from Russia has practically vanished, while that from Germany does not exist. Norway supplied us in the 10 months in 1915 mentioned above with 14,006 tons (bleached) and 50,980 tons (unbleached) chemical dry pulp, valued at £740,915.

Of mechanical pulp (wet) Canada had before the war increased yearly her export to this country, in 10 months of 1914 sending 107,333 tons, of the value of £252,450. Her export during the same period of 1915 dropped to 22,289 tons, valued at £65,651.

The importance of wood pulp to the paper-making trade may be gauged from the fact that out of a total value of all paper-making materials imported during the 10 months ended October 31, 1915—namely, £5,102,007—that of wood pulp was £4,361,419.—The Times.

THE DRY ZONE EXPERIMENT STATION, ANURADHAPURA.

(Progress Report from December, 1915, to February 15, 1916.)

OIL PALMS.

1. The palms in this plot appear to be coming on well. The intersown cow-peas have been dug in round the plants and the land ploughed.

As these plots are rather high the matter of irrigating them had to be considered. It was first found that the new channel through the plots possessed only one bank so that water could not be headed up. The channel was drained and cleaned, the mud used to form the second bank.

2. No regulators having been made, the irrigation officer has kindly estimated for these two which will be required. Meanwhile earth dams have been thrown across with pipes in, kindly lent by the Government Agent.

In this matter it was found there was a splendid flow of water sufficient to flood the highest plots when high-banked field-canals were constructed to carry the water.

3. The whole of this 3 acres is now satisfactorily irrigated and various legumes will be again sown between the palms.

In the same way all the other plots can be irrigated and this year all plots will be shown carrying crops of maize, dura, linseed, cotton, ajowan, teff-grass, teesinte (fodder), beans, tobacco, as well as the permanent crops of fruit, sugar cane and other economic products under irrigation.

It is hoped in this way to show local cultivators what can be done with their paddy fields during the dry season when there is not enough water for paddy but sufficient for other grain and leguminous crops.

The importance of the latter grown on paddy fields—provided they are drained—is a matter that requires bringing to the notice of the goiya not only from the food point of view, but as a fertiliser of his fields for the benefit of his paddy crop.

It is hoped that local villagers can be induced to visit the Experiment Station more frequently.

4. The Chena Mohandirams made an inspection of the plots with the Manager and were much impressed by the variety and condition of crops.

DURA.

5. The pink and red varieties are making a very satisfactory show and this year the seed has ripened as it should in the dry weather.

There is no sign of any disease such as smut, stem-borer, or aphis, but the crop is open to attack by parrots and monkeys attracted by its sweet and nutritious grain.

Seed of the best heads is being carefully collected for re-sowing. The Indian Sorghums are doing very poorly in comparison.

COTTON.

6. This is not doing well, but may improve later under irrigation.

TOBACCO.

7. These plots are looking in first-class condition and MR. SCHERRFIUS was very pleased with them—"as good in growth as those at Jaffna." A leaf disease due to soil conditions, quite common in America, but unknown in the Jaffna trial grounds has appeared in the plots here.

White Burley, Dumbara, and Zimmar's Spanish are the varieties planted.

A curing-shed will be erected shortly.

LEGUMES.

8. The climbing bean, Vigna lunatus, is yielding a very high crop, as are the cow-peas.

Cluster-beans, both erect and creeping are doing well and will be sown again under irrigation.

Groundnuts require re-sowing under irrigation as two of the varieties failed to germinate well.

The Egyptian Dersin, which at first appeared a failure owing to too much rain, has now recovered and in the higher parts of the plot is making quite a good growth though not up to the Egyptian standard in luxuriance. It is flowering freely, though the heads are small. The seeds will be collected; the green stuff ploughed in to improve the soil and spread the bacteria necessary to the formation of the nitrogen nodules which creates good growth in clover crops. The fresh seed will then be re-sown in the same plot and lightly irrigated.

OILS.

9. The Giant Russian Sun-flower has done much better here than at Peradeniya. The biggest head measured 1 ft. 3 in. in diameter and an average of 11 ft. 2 in. in diameter. The seeds appear full of kernel and to have a good oil content.

FRUIT PLOTS.

All legumes have been part harvested, pulled up and dug in round the trees, and plots resown with legumes under irrigation.

DUDLEY S. CORLETT.

WHAT IS A FRESH EGG?

Anent the question asked in The Tropical Agriculturist for March as to what is a fresh egg, the following description may be of interest:—

A fresh egg, to be eggsact, is an egg whose eggsellence is only eggseeded by its eggspressiveness, there being few eggstant: one recently brought into eggsistence, and not eggshumed from cold storage, one that does not eggsplode and eggshale eggstremely eggsasperating and ineggsterminable odours, and eggscite eggspressive eggsclamations when the interior is eggsposed for eggsamination and eggstraction by any eggscision of the eggsterior. Fresh eggs are eggshibited on eggstraordinary occasions by the eggsclusive and eggstravagant. No egg is as fresh as the eggsperienced and uneggsemplary retailer would make out, who egged on by the eggsultant producer and commission man, eggsagerates its freshness eggstemporaneously and eggsacts an eggsorbitant price in eggschange therefor, afterwards eggspertly eggsplaining and eggsonerating himself when eggsecrated by his eggspostulating customer.

H. F. M.

CASTOR.

A test was made with a series of nine varieties received from Bombay, Madras, and Java, and the oil content determined by the Agricultural Chemist. The results are as follows:—

Serial No.	Name of Variety.	Percentage of oil from Kernel	Yield of seed per acre (lb.)	Yield of oil per acre (oils)
1.	Madras	64·86	585	302
2.	Java	64·83	450	267
3.	Kyauksè	67·51	1,200	611
4.	Big Paras	64·31	735	396
5.	Bresbani	66·13	420	250
6.	Purple stemmed	64·22	615	319
7.	Dharwat	66·21	570	321
8.	Big Chaum	66·70	645	420
9.	Madras	65·70	750	395

The Kyauksè variety was grown from seed received from the district of that name, where there is a considerable area grown from seed distributed by the Deputy Commissioner some three years ago. Its superior yield may be due to its acclimatisation or to the local seed being fresher. This is being multiplied for distribution. Nos. 2 and 5 have also been retained because, although their yield of seed is small, they possess other important characters. No. 2, the Java variety, is a bush type, very early ripening, and may be suitable for other classes of soil in the dry zone. No. 5 has a dark red whole coloured seed, quite unlike the others, and may be useful for crossing purposes.—Rept. of the Hmawbi Agric. Stn., Burma.

THE CULTIVATION OF LIMES.

J. B. HARRISON AND C. K. BANCROFT.

The minimum planting distance recommended for lime trees in the previous article on good flat land was 20 x 20 feet, while on steep slopes it was considered that the trees could be planted as close as 16 x 16 feet. The vigorous growth attained by the trees on good land in the colony does not, in our opinion, permit of their being planted closer to each other without undue interference resulting from the feeding area being too small for the roots of fully developed trees. If the trees are planted at the above distance it is obviously inadvisable to interplant any permanent crop among them; while on the other hand, the spacing of trees at greater distances apart, so as to allow of interplanting being done, must interfere with the economical working of the cultivation, since from the points of yield per acre and especially of low cost of labour in collecting the fruit, it is desirable to have large numbers of trees of the same kind per acre, provided that they do not interfere with each other's full development.

Interplanting of rubber with limes is very strongly condemned, inasmuch as (apart from the above considerations) the presence of an intercrop with rubber increases the cost of collecting latex from the latter to an extent which at the present range of prices for rubber is prohibitive.

Both Para rubber and lime trees are essentially surface-feeders, their roots forming an anastomosing network near the surface, while both are very susceptible to root diseases.

COST OF ESTABLISHING A LIME PLANTATION.

The establishment of a lime plantation may be effected either from virgin or secondary forest or from an existing or abandoned cultivation. In the latter cases the actual amount of preparation of the land required will depend on the condition of the land previous to the commencement of operations for lime planting. It is not possible under these circumstances to give even an approximate estimate of the probable cost of preparing the land. We propose, therefore, to confine our estimate to the cost of establishing a lime cultivation from forest land in the colony.

The plantation should be laid out in 50-acre sections with narrow belts of forest trees left standing between the different sections. The tops of hills should not be bared nor should very steep slopes be denuded of their forest growth. It is essential from the point of view of high yields of limes per tree that the trees be protected from the prevailing winds. Occasional gusts do not do much harm, but exposure to persistent winds results in grave injury to the young growing shoots, giving rise to what is known as "stag-head."

Flat, low-lying river lands have to be empoldered and must be provided with drains which are capable of running off water fairly rapidly. The usual practice is to lay out these lands in long, relatively narrow, rectangles, or beds surrounding them by wide trenches for draining purposes and throwing the earth so derived to the outside of the trenches in order to make up the dams. Smaller cross drains, resulting in the production of approximately square or small rectangular areas, are led in to these larger channels and the water is thus run off at low tides of the river. When the estate has been laid out, and, if on flat land, empoldered, the forest is underbushed and felled and the timber stacked for burning. The drainage of the different sections is then attended to. After this is completed the land is lined, holed and planted. The subsequent operations are supplying, weeding, mulching, pruning, and the treatment of diseases and pests.

[The total estimate of bringing to the bearing stage (6th year) an acre of limes in a cultivation of 100 acres is $165.]

This estimate provides for thorough burning and clearing of the forest and for fairly clean weeding. It does not include roads, which are necessary on an estate in the interior of the colony, or drainage. The cost of cart roads may be estimated at $ 20 per acre and of drainage on an estate in the interior, another $10. On the low-lying land on the river banks no roads are required as the trenches serve this purpose: the drainage of these lands is, however, more costly and may be estimated at 15 per acre for establishment and $3·00 per acre per annum for maintenance, making a total of $30

The cost of bringing an acre of limes to the bearing stage in a cultivation of 100 acres may, therefore, be taken roughly as $195 or £40 12*s.* 6*d.*

[The cost of machinery for a citrate of lime factory capable of dealing with 8,000 to 10,000 barrels of fruit per annum is $5,636. For making concentrated lime juice an estimate for a plant capable of dealing with 8,000 to 10,000 barrels of limes per annum costs $4,189.]

A proprietor possessing an area of say 20 acres would require at the commencement, the following equipment:—

Hand or cattle mill	...	...	$ 180·00
1 copper tayche, 50 gals,	...	...	150·00
1 do , 80 gals.	...	...	180·00
2 Vats 2' 6" x 2' 6" x 5'	...	...	20·00
		Total...	$ 530·00

Should the proprietor be desirous of making distilled oil of limes, then he will require a still of capacity of 50 or 60 gals.

Later another tayche will be required of 100 gals. capacity. A storage vat, and a copper still will also be required.

The type of mill given in the above is a 3-roll horizontal mill, 18" x 10", as supplied by Messrs. Geo. L. Squire, M.F.G. Co, Buffalo, N.Y., U.S.A.

A cheap hand or cattle mill can be made of a green-heart frame with rolls of turned greenheart.

A complete factory for a large acreage should be capable of preparing lime juice of high quality from selected fruit, concentrated juice and citrate of lime according to the relative market value of these products. Granite rolls or a subsidiary mill with granite rolls will be required for making the first-mentioned product.

If the factory is run as a subsidiary to a sugar factory the requirements will naturally be less, and it will be found that several of the above items may be dispensed with and the cost of equipment therefore appreciably lessened.

—Br. Guiana Bd. of Agric. Journal.

SESSAMUM.

The most important characters in sessamum from the point of view of variation are the following:—

(i) Arrangement of leaves on the stem. Usually the leaves occur opposite and in pairs, but sometimes there is a decided intermede between corresponding leaves.

(ii) The branching habit. This is the most important character and enables us to separate the sessamum into short and long-lived types. In the short-lived types all, or nearly all the axils of the leaves on the main stem produce short-flowering branches giving rise to a practically sessile fruit in the axil. In the long-lived type about two-thirds or more of the length of the stem is occupied by leaves which produce long vegetative branches.

The latter again as well as the top portion of the main stem bear sessile fruits in the axils of their leaves.

Unfavourable conditions, such as too little or too much moisture can inhibit the branching habit, but in such cases the true type of the plant is shown by the occurrence in the axil of a short vegetative shoot bearing one or two pairs of leaves and a terminal bud.

(iii) The colour of the flower. The lip of the corolla has a pinkish red band and the inside has mottled red and yellowish markings. The intensity of the red colouration varies much. Plants with pure white flowers were met with and one plant was found which had the inside of the corolla mottled with very dark red markings.

(iv) The number of cells in the fruit capsule. This is always double the number of carpels, and fruits may be four, six, eight, or ten celled. The four-celled fruits are usually oblong in shape with flattened sides and a longitudinal grove running down each side. The six, eight, and ten celled fruits are more or less ovoid in shape.

(v) The degree of pubescence. Some plants are much hairier than others.

(vi) Colour. This varies from a light to a glaucous green.

(vii) The colour of the ripe seed. This may be white, brown or black.

It is not yet certain how far these characters are constant and a large number of single plant selections have been made to test this point next year and for the production of pure types.

The composition of different cultivators' varieties was seen to vary greatly. In some of these one type was largely predominant and the variety was comparatively pure. In others as many as 20 different types could be distinguished. It is clear that if there is much variety among the types in yield and oil content, there is much scope for improvement in the case of such mixed crops.—REPT OF THE HMAWBI AGRIC. STN., BURMA.

PLANTING EXPERIMENTS IN CEYLON.

The following is extracted from the minutes of the meeting of the Committee of Agricultural Experiments held at Peradeniya on March 9th, 1916 :--

DROUGHT AND PRUNED TEA.

In referring to the Progress Report MR. GOLLEDGE asked what had been the effect on the tea bushes pruned in January of the drought.

MR. CORLETT replied that in the 5 acres pruned in January and in which a live-branch had been left on each bush, only six bushes had succumbed, but in the five acres pruned in June last and now being plucked 39 had died, which points to the value of the live-branch in helping the pruned bushes through the dry weather.

MR. GARRICK asked whether such a live-branch left after pruning was not contrary to MR. SPEYER'S methods of eradicating the borer by means of pruning?

MR. SPEYER replied that it undoubtedly was.

BARK-ROT ON HEVEA.

MR. GOLLEDGE asked if the acting Mycologist had obtained any results as yet from his treatment of the Gangaroowa trees.

MR. BRYCE replied :—The trees on Gangaroowa were examined on March 7th. The cow-dung mixtures were scraped off, and observations made on rate of healing of wounds showing exposed wood. The results were remarkably uniform over trees treated with cow-dung, clay and sulphur,

trees treated with cow-dung and clay, and untreated control trees. It would thus appear that the application of cow-dung and clay mixtures does not have any marked stimulating effect on the rate of healing of wounds.

MR. HUYSHE ELIOT asked if any trees had been treated with Carbolineum.

MR. BRYCE replied in the negative.

MR. NEIL CAMPBELL thought that the effect of the south-west monsoon on the newly-tapped surfaces and of the morning and evening sun would repay careful study.

MR. WILKINS thought that MR. BRYCE'S experiments were carried out with only a few trees and under unfavourable conditions of a drought. His own experience of the method was gained over large areas of rubber in Kalutara where the practice of claying the trees was habitual and had resulted in excellent results in good bark-renewal and prevention of disease as compared with neighbouring estates which did not practise the method.

MR. GARRICK enquired how often the clay mixture was applied in these cases, as he found he could only afford to apply it once in three months and by that time the disease had often made considerable advances on the bark.

MR. WILKINS replied that it must be put on frequently, at least after every quarter inch of tapping.

MR. GOLLEDGE deprecated the method as covering up bad tapping, making it impossible for the Visiting Agent to report on the tapping work. He would, therefore, like it to be conclusively proved to be of great benefit before the method was universally adopted.

MR. GRÆME SINCLAIR agreed with this and thought the matter should be thoroughly investigated on large areas.

THE CHAIRMAN said arrangements would be made for the Mycologist to visit Kalutara and study the methods employed and compare results with our own investigations. With regard to what MR. GOLLEDGE had said, it was the business of the Department to determine the benefits if any of claying. If the process proved beneficial to renewing bark it was then for the planters to decide whether or not in the circumstances described they would adopt it.

PADDY.

THE CHAIRMAN called attention to the new Gangaroowa paddy experiments and to the straw and grain on exhibition. It would be noticed that this year's straw after the draining of the fields was a foot longer than that of last year and finer in every way, whilst the yield of paddy was an average of 48 bushels per acre instead of 33.

MR. T. Y. WRIGHT thought these experiments of the greatest value seeing the present high price of both rice and straw.

APPEAL FOR THE HELP OF SUFFERING SERBIA.

The Serbian Minister has the honour to convey his warmest thanks to all the benevolent donors who generously have sent until now their donations through the Serbian Legation for several Relief Funds existing in Serbia.

At the same time the Serbian Minister has to announce that several Relief Funds in Serbia are sending through him their appeal to all benevolent men and women, fathers and mothers and all philanthropic institutions, painting the horrible suffering of the Serbian Refugees, the starvation of the population staying at home in Serbia, the painful scenes of the desperate

mothers and frozen children. Many thousands of Refugees are dispersed in the villages of Greece, in the Albanian desert or in the rocky hollows of Montenegro, without home, without food! The life of these Refugees is now nothing else than a slow dying out. This help will be a real help only if it comes as quickly as possible.

Such appeals have been made from the following funds :—

THE SERBIAN ARCHBISHOP OF BELGRADE'S RELIEF FUND FOR THE FAMILIES OF THE FIGHTING MEN.

THE ST. HELEN'S RELIEF FUND FOR THE ORPHANS, whose fathers were killed in the war.

THE PARLIAMENTARY FUND FOR THE RELIEF OF SERBIAN REFUGEES.

THE SERBIAN RED CROSS FUND FOR THE WOUNDED SOLDIERS.

The generous donors, who would help any of the above mentioned funds are kindly requested to send their contributions through the Serbian Legation, 195 Queens Gate, London, S. W.

Please do not forget to mark for which of the Funds the donation is destined, which will be duly acknowledged.

RAISING FOOD SUPPLIES LOCALLY.

Sir,

Now that imported stores are getting so expensive I have just been wondering if the Island could not supply more than it does. There are arrowroot and tapioca, for instance, that need not be imported at all; the former grown and prepared in the Island is very good indeed. Tapioca too grows like a weed and is very simple to prepare. We made it many years ago in Haputale and only had a book to guide us. The Manioc (tapioca) roots are washed, grated and reduced to flour exactly like arrowroot, but before the flour is quite dry, a wooden comb (made by a carpenter) is run through the flour to give it a granulated appearance, and it is dried in the sun, or in a cool oven if the weather is wet. Then cornflour is easily prepared from Indian corn. This grows well on the Badulla side and used to be sold at a rupee a bushel in the coffee days. Probably the cultivation has lapsed in these days of rubber! Then our school gardens might try poultry-rearing on a fairly large scale. Many people who have poultry would be glad to give a rooster or settings of eggs till a proper start is made. Looking after the chickens would give employment to old native men or women, who are unable to work in paddy fields. Anything that would increase our food supply locally seems worthy of attention. We are too dependent on tinned stuffs which, apart from the expense, have in many cases really little nourishment. Potatoes grow well in the Wilson's Bungalow district, and onions, sweet-potatoes, brinjals and such like can be grown in quantities throughout the low-country. In late years it has been so easy getting imported goods that the cultivation of local vegetables has gone largely out of favour, but in these days when imported articles have gone up 50 or 100 per cent., it behoves us to make the most of our Island's resources.

Yours, etc.,
PLANTER'S WIFE.

Dooroomadella,
Gammadua, 18th March, 1916.

PROF. INOUYE of the Silk Technological College at Uyeda, Shinshiu, has discovered new methods of feeding the silk worms by sprinkling the principal silk ingredient over the mulberry leaves and of obtaining nourishment out of the cocoons' waste, which produce better quality of silk.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Socotrine cwt.	Fair to fine	40/ a 50/
Zanzibar & Hepatic ,,	Common to good	40/ a 70/
ARROWROOT (Natal) lb.	Fair to fine	5d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£7 10/ a £7 15/
East Indian, bleached ,,	Fair to good	£8 10/a £8 12/6
,, unbleached ,,	Dark to good genuine	£6 5/ a £7
Madagascar ,,	Dark to good palish	£7 15/ a £8 2/6
CAMPHOR, Japan lb.	Refined	1/7 a 1/8
China cwt.	Fair average quality	155/
CARDAMOMS, Tuticorin	Good to fine bold	5/9 a 6/
per lb.	Middling lean	4/8 a 5/4
Malabar, Tellicherry ,,	Good to fine bold	5/9 a 6/3
Calicut ,,	Brownish	3/9 a 5/3
Mangalore ,,	Med Brown to good bold	4/ a 6/4
Ceylon, Mysore ,,	Small fair to fine plump	4/ a 6/4
Malabar ,,	Fair to good	3/2 a 3/4
Seeds, E. I. & Ceylon ,,	Fair to good	4/ a 4/3
Ceylon "Long Wild" ,,	Shelly to good	2/3 a 3/6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	50/ a 60/
Japan ,,	Fair bright small	60/ a 70/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜ d a 7 d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾ d a 4½d
	Renewed	3d a 5½d
	Root	1⅜d a 4d
CINNAMON, Ceylon 1sts.	Good to fine quill	1/3 a 1/9
per lb. 2nds.	,, ,,	1/2 a 1/7
3rds.	,, ,,	1/1 a 1/6
4ths.	,, ,,	1/ a 1/3
Chips.	Fair to fine bold	2d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	1/ a 1/2
Amboyna ,,	Dull to fine	10d a 10½d
Zanzibar ,,	Fair and fine bright	5⅝d a 6¼d
Madagascar ,,	Fair	7d
Stems ,,	Fair	2d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	63/ a 80/
COCOA, Ceylon Plant. ,,	Special Marks	81/ a 88/6
	Red to good	73/ a 80/6
Native Estate ,,	Ordinary to red	42/ a 68/
Java and Celebes ,,	Small to good red	30s a 93s
COLOMBO ROOT ,,	Middling to good	15/ a 22/6
CROTON SEEDS, sifted ,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	130/ a 150/
GINGER, Bengal, rough ,,	Fair	19/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	35/ a 74/
Cochin, Rough ,,	Common to fine bold	22/6 a 27/
	Small and D's	20/
Japan ,,	Unsplit	20/
GUM AMMONIACUM ,,	Ord. Blocky to fair clean	40/s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10/
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
	,, ,, red	£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	26/ a 32/6
Turkey sorts ,,	,, ,,	37/ a 57/6
Ghatti ,,	Sorts to fine pale	17/ a 27/
Kurrachee ,,	Reddish to good pale	22/6 a 32/6 nom.
Madras ,,	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£6 a £6 10/
	com. stony to good block	40s a £5
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	57/6 a 67/6
Somali ,,	,, ,,	52s 6d a 55s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	35s a 40s
pickings ,,	Low to good pale	15/ a 27/6
siftings ,,	Slightly foul to fine	18s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	2/4
Ceylon, Straits, ,,	Crepe ordinary to fine	2/2½
Malay Straits, etc. ,,	Fine Block	2/4¼
	Scrap fair to fine	1/8 a 1/9
Assam ,,	Plantation	1/10
,,	Fair 11 to ord. red No. 1.	1/3 a 1/6
Rangoon ,,	,, ,, ,,	1/2 a 1/4

	QUALITY.	Quotations
INDIA RUBBER lb.		
Borneo ,,	Common to good	9d a 1/3
Java ,,	Good to fine red	1/3 a 1/6
Penang ,,	Low white to prime red	9 d a 1/4
Mozambique ,,	Fair to fine red ball	1/9 a 2/1
,,	Sausage, fair to good	1/9 a 2
Nyassaland ,,	Fair to fine ball	1/9 a 2
Madagascar ,,	Fr. to fine pinky & white	1/4 a 1/6
,,	Majunga & blk coated	1/ a 1/2
,,	Niggers, low to good	6d a 1/6
New Guinea ,,	Ordinary to fine ball	1/4 a 1/7
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	3s 3d a 3s 8d
,,	Consuming mid. to gd.	2s 9d a 3s 2d
	Ordinary to middling	2s 4d a 2s 9d
,,	Mid. to good Kurpah	1s 11d a 2s 5d
,,	Low to ordinary	1s 6d a 1s 9d
,,	Mid. to fine Madras	1/11 a 2/9
MACE, Bombay & Penang	Pale reddish to fine	2/4 a 2/6
per lb.	Ordinary to fair	2/ a 2/2
Java	,, ,, good pale	2/ 1 a 2/4
Bombay	Wild	1/
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	9½d a 10½d
	80's	7½d
	110's	6½d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20
NUX VOMICA, Cochin	Ordinary to good	13/6 a 15
per cwt. Bengal	,, ,,	12/
Madras	,, ,,	12/ a 13/
OIL OF ANISEED lb.	Fair merchantable	5/2
CASSIA ,,	According to analysis	2/8 a 2/11
LEMONGRASS oz.	Good flavour & colour	2¼d
NUTMEG ,,	Dingy to white	1½d a 1⅞d
CINNAMON ,,	Ordinary to fair sweet	4d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/6½
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	5d
Ceylon ,, ,,	Fair to fine bold heavy	5d a 5⅝d
Singapore ...	Fair	4½d
Acheen & W. C. Penang	Dull to fine	5d a 5½d
(White) Singapore ,,	Fair to fine	8½d a 8⅞d
Siam ,,	Fair	8½d
Penang ,,	Fair	7⅞d
Muntok ,,	Fair	9d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 4/
Canton ,,	Ordinary to good	1/10 a 3/6
High Dried ,,	Fair to fine flat	11d a 1/1
	Dark to fair round	9 d a 10d
SAGO, PEARL, large—cwt	Fair to fine	18/
medium ..	,, ,,	16/
small ..	,, ,,	13/ a 14/
Flour ..	Good pinky to white	10/ a 11
SEEDLAC cwt.	Ordinary to gd. soluble	65/ a 75/
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 8½d
	Fair greenish	3d a 4½d
	Common specky & small	1½ d a 2½d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	72/6 a £6
Bombay ,,	,, ,,	85/ a £6 10/
Mergui ,,	Chicken to bold	£8 12/6 a £145
Manilla ,,	Fair to good	£7 17/6 a 13 10
Banda ,,	Sorts	50/ nom.
Green Snail ,,	Small to large	70/ a 85/
Japan Ear ,,	Trimmed selected small to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	14/ a 15/
per cwt. Madras	Inferior to good	6/ a 10/
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	12/ a 26/
	Pickings	6/6 a 19/
TURMERIC, Bengal cwt.	Fair	12/ a 13/
Madras ,,	Finger fair to fine bold	14/ a 16/
Do. ,,	Bulbs ,, ,, [bright	12/ a 13/
Cochin ,,	Finger fair	13/ nom.
	Bulbs ,,	11/6 a 12/
VANILLOES— lb.		
Mauritius ... } 1sts.	Gd. crystallized 3½a 8½ in.	9/6 a 15/
Madagascar ... } 2nds.	Foxy & reddish 3½a ,,	9/ a 12/
Seychelles ... } 3rds.	Lean and inferior	9/ a 9/6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares cwt.	Good white hard	47/6